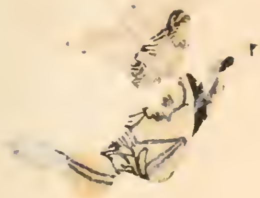
SCIENCE OF THE BIBLE

BRENNAN



THE

SCIENCE OF THE BIBLE

BY

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PREFACE.

THESE pages aim to give an honest presentation of the branches of science touched upon in the Sacred Scriptures as compared with the same branches studied from a purely natural or secular standpoint. Astronomy, Optics, Geology, Biology, and Anthropology, in many portions of the Bible stand out in clear prominence, therefore these branches will form the subject matter of my comparative study. The fair minded reader will, I think, be convinced that no well established fact or principle of science is contradictory to any passage of the Bible properly and honestly interpreted.

There is no bending of science to suit the scriptural text. The teachings of science drawn from the latest and most correct sources are put down independently of any ulterior motive. The passages of Scripture said to contradict science are then taken up, and the apparent conflict is harmonized.

Science has undoubtedly made transcendent progress within recent years. This progress is due in great measure to the continual changes occasioned by the rapid frequency of new discoveries. Indeed there is no feature of science as extraordinary as its changeableness.

The science of twenty years ago is to-day almost obsolete. Every new discovery puts in hazard or greatly modifies some old favorite theory. The science text-books of our youthful days would be much more harmful than helpful in the hands of the pupils of to-day.

Under such circumstances is it not strange indeed to see the arrogance with which many so-called scientists condemn everything that stands in the way of their ephemeral theories? The holiest convictions and most sacred and best established traditions of the race must vanish at the touch of these sciolists.

However, it can be truthfully stated that it is only the braggadocios and tyros of science that are so presumptuous. Or to be more precise, this arrogance is but the expression of agnosticism parading in the garb of science.

The great men who have done most for science are not of this temper. The Copernicuses, Newtons, Amperès, Faradays, Oersteds and Henrys were modest men.

The great physicist, Clerk-Maxwell, declared towards the close of his life that all the agnostic hypotheses he had ever known need a God to make them workable.

Sir William Thompson, professor of natural philosophy in Glasgow University, and who has probably done more for the advancement of physical science than any other living man, had this to say recently: "One word characterizes the most strenuous of the efforts for the advancement of science that I have made perseveringly through fifty-five years; that word is *failure;* I know no more of electric and magnetic force, or of the relation between ether, electricity and ponderable matter, or of chemical affinity, than I knew and tried to teach my students of natural philosophy fifty years ago in my first session as professor."

A considerable amount of space comparatively is devoted in these pages to Geology, although it would appear that only a few passages of scripture really bear upon this science. Still Geology in one of its branches, Paleontology, or the science of fossils, enters largely into Biology, Anthropology, the treatment of the questions of the Antiquity of Man and the Deluge. What we know of prehistoric Biology and Anthropology we learn entirely from the study of fossils.

Hence a great deal of Geology is given which may at first sight seem unnecessary, or even foreign to the subject matter under consideration. But to avoid continual reference to Geology when treating of the other sciences I thought it best to give all its results under one caption.

Because I have treated the sciences separately in order to avoid calling them up promiscuously when needed, this treatise may appear somewhat shapeless and of faulty construction. Still I thought it preferable to use this method rather than that of mingling up the sciences interminably together.

I have recognized the world as older than Usher makes it, and favored the theory of a partial deluge, because these views are legitimate interpretations of Genesis and held by many of the greatest commentators and are more in accord with the present teachings of science.

THE AUTHOR.

THE

SCIENCE OF THE BIBLE.

CHAPTER I.

MOSES.

This first chapter is devoted to a short biographical sketch of Moses, the author of the Pentateuch. By establishing at the outset the character of the great prophet for honesty, sincerity and candor, it will obviate the necessity of continual reference to him when we come to the Study of the Pentateuch.

EXODUS.—The first and second chapters of the book of Exodus contain the following narration: "These are the names of the children of Israel, that went into Egypt with Jacob; they went in every man with his household, Ruben, Simon, Levi, Juda, Issachar, Zabalon and Benjamin, Dan, and Nephthali, Gad and Aser.

And all the souls that came out of Jacob's thigh, were seventy: but Joseph was in Egypt.

After he was dead, and all his brethren, and all that generation, the children of Israel increased, and sprang up into multitudes, and growing exceedingly strong they filled the land.

In the meantime there arose a new king over Egypt, that knew not Joseph : and he said to his people : Behold the people of the children of Israel are numerous and stronger than we.

Come let us wisely oppress them, lest they multiply : and if any war shall rise against us, join with our enemies, and having overcome us, depart out of the land.

Therefore he set over them masters of the works, to afflict them with burdens : and they built for Pharaoh cities of tabernacles, Phithom and Ramesses.

But the more they oppressed them, the more they were multiplied, and increased :

And the Egyptians hated the children of Israel, and afflicted them and mocked them ;

And they made their life bitter with hard works in clay, and brick, and with all manner of service, wherewith they were overcharged in the works of the earth.

And the king of Egypt spoke to the midwives of the Hebrews : of whom one was called Sephora, the other Phua, commanding them : When you shall do the office of midwives to the Hebrew women, and the time of delivery is come : If it be a man child, kill it ; if a woman, keep it alive.

But the midwives feared God, and did not do as the king of Egypt had commanded, but saved the men children.

And the king called for them and said: What is it that you meant to do, that you would save the men children?

They answered: The Hebrew women are not as the Egyptian women; for they themselves are skillful in the office of a midwife; and they are delivered before we come to them.

Therefore God dealt well with the midwives: and the people multiplied and grew exceedingly strong.

And because the midwives feared God, he built them houses.

Pharaoh therefore charged all his people, saying: Whatsoever shall be born of the male sex, ye shall cast into the river; whatsoever of the female, ye shall save alive.

After this there went a man of the house of Levi, and took a wife of his own kindred.

And she conceived, and bore a son: and seeing him a goodly CHILD, hid him three months.

And when she could hide HIM no longer, she took a basket of bulrushes, and daubed it with slime and pitch: and put the little babe therein, and laid him in the sedges by the river's brink.

His sister standing afar off, and taking notice what would be done.

And behold the daughter of Pharaoh came

down to wash herself in the river; and her maids walked by the river's brink. And when she saw the basket in the sedges, she sent one of her maids for it: and when it was brought, she opened it, and seeing within it an infant crying, having compassion on it she said : This is one of the babes of the Hebrews.

And the child's sister said to her : Shall I go, and call to thee a Hebrew woman, to nurse the babe ?

She answered : Go. The maid went and called her mother.

And Pharaoh's daughter said to her : Take this child and nurse him for me : I will give thee thy wages. The woman took, and NURSED the child : and when he was grown up she delivered him to Pharaoh's daughter.

And she adopted him for a son, and called him Moses, saying : "Because I took him out of the water."

ISRAELITES IN EGYPT. — The Hebrews are a very ancient people and most probably received their name through Abraham, who emigrated from Ur of Chaldea into Palestine or Canaan in the year 1921 B. C.

The Canaanites called the stranger Eber (beyond), because he came from beyond (eber) the Euphrates. Abraham had an only son, Isaac, who had a son Jacob. The

Israelites were named for Jacob who had been surnamed Israel.

Jacob had twelve sons, Joseph being the eleventh. Jacob loved Joseph more dearly than any of his other sons, and bestowed on him openly many tokens of his favoritism. Joseph thereby incurred the hatred and enmity of his brothers, who finally conspired to sell him as a slave to some Ishmaelite merchants. These traders bore the young man away to Egypt and sold him to the first officer of Pharaoh's guard, Putiphar.

Joseph because of his wisdom and virtues reached great distinction in Egypt, becoming indeed the first minister of the country. During the sway of an universal famine he invited Jacob and all his family to Egypt, where they were welcomed with great kindness by Pharaoh.

The Israelites, being a pastoral people, established themselves in Goshen, a part of Egypt very favorably adapted to the raising of flocks.

In progress of time the Israelites rapidly increased in numbers and possessions. The Egyptians regarded this rapid growth of the descendants of Jacob as a menace to their own safety and resolved to slowly exterminate them. Accordingly the Egyptians reduced the Israelites to a condition of the basest bondage, imposing upon them the most difficult and painful tasks.

It was finally decreed by Egypt's ruler, as described in Exodus, that every male child born of the Hebrews should be thrown into the Nile. It was during the progress of this bitter persecution that Moses was born. His father, Amram, and his mother, Jochebed, were both descendants of Levi, the third son of Jacob. Moses was born in Heliopolis in the year 1571 B. C.

Childhood.—All accounts agree that the infant Moses was a most beautiful and winsome babe. The united artifices of his mother Jochebed and his sister Miriam succeeded in eluding the vigilance of Pharaoh's myrmidons and saving the darling infant's life for the space of three months. Escape for the child being no longer possible they hid him in a neatly fashioned basket of papyrus and placed it among the reeds of the sedgy Nile, close to the spot where Thermuthis or Merris, Pharaoh's daughter, was wont to bathe.

With beating heart and burning brow the eager sister, concealed behind a friendly bush, watched for the coming princess. Thermuthis approaches the familiar spot and perceiving the basket opens it and discovers the laughing babe. The princess was at once charmed with the sweet-faced, red-lipped smiling boy and resolved to save him.

Now, Miriam opportunely appears and volunteers to find a Hebrew woman, if the princess so desired, to nurse the babe. Thermuthis gladly yields and the child's mother, Jochebed, is secured as a nurse.

The princess instructed the willing mother to carefully rear the child at her expense.

When the child was sufficiently grown he was taken to the palace and given to Pharaoh's daughter, who adopted him for her son. Josephus tells us that Moses is the Egyptian for SAVED FROM THE WATERS.

Nature had favored Moses with a transcendently gifted mind. The Princess Thermuthis bestowed the greatest care upon his education and culture. She surrounded him with the ablest masters and had him thoroughly instructed in all the knowledge and science of Egypt, Greece, Assyria and particularly of Chaldea.

JOSEPHUS.—"For Moses was the son of Amram, who was the son of Caath, whose father, Levi, was the son of Jacob, who was the son of Isaac, who was the son of Abraham. Now Moses' understanding became superior to his age, nay, far beyond that standard; and when he was taught, he discovered greater quickness of apprehension than was usual at his age; and his actions at that time promised greater, when he should come to the age of a man. God did also give him that tallness, when he was but three years old, as was wonderful; and for his beauty, there was nobody so unpolite as, when they saw Moses, they were not greatly surprised at the beauty of his countenance: nay, it happened frequently, that those that met him as he was carried along the road, were obliged to turn again upon seeing the child, that they left what they were about, and stood still a great while to look on him; for the beauty of the child was so remarkable and natural to him on many accounts, that it detained the spectators, and made them stay longer to look upon him.

Thermuthis, therefore, perceiving him to be so remarkable a child, adopted him for her son, having no child of her own. And when one time she had carried Moses to her father, she shewed him to him, and said she thought to make him her father's successor, if it should please God she should have no legitimate child of her own; and said to him, "I have brought up a child who is of a divine form, and of a generous mind; and as I have received him from the bounty of the river, in a wonderful manner, I thought proper to adopt him for my son, and the heir of thy Kingdom." And when she had said this, she put the infant into her father's hands; so he took him, and hugged him close to his breast; and on his daughter's account, in a pleasant way, put his diadem upon his head; but Moses threw it down to the ground, and, in a puerile mood, he wreathed it round, and trod upon it with his feet; which seemed to bring along with it an evil presage concerning the Kingdom of Egypt. But when the sacred scribe saw this, (he was the same person who foretold that his nativity would bring the dominion of that kingdom low,) he made a violent attempt to kill him: and crying out in a frightful manner, he said, "This, O King, this child is he of whom God foretold, that if we kill him we shall be in no danger; he himself affords an attestation to the prediction of the same thing, by his trampling upon thy government, and treading upon thy diadem. Take him, therefore, out of the way, and deliver the Egyptians from the fear they are in about him; and deprive the Hebrews of the hope they have of being encouraged by him." But Thermuthis prevented him, and snatched the child away. And the King was not hasty to slay him. God himself, whose providence protected Moses, inclining the King to spare him. He was, therefore, educated with great care. So the

Hebrews depended on him, and were of good hopes that great things would be done by him; but the Egyptians were suspicious of what would follow such his education. Yet because, if Moses had been slain, there was no one, either akin or adopted, that had any oracle on his side for pretending to the crown of Egypt, and likely to be of greater advantage to them, they abstained from killing him." (Ant., II, Chap. 9, 6–7).

In his early manhood Moses stood immensely high with the ruling powers of Egypt. He held a princely rank at Court and is said to have become a priest and to have led with great success Egyptian armies against Ethiopia.

When Moses had attained his thirtieth year he forsook the palace of the Pharaohs, and made his home with the oppressed Hebrews, his countrymen, espousing their cause and boldly seeking the amelioration of their sad condition.

On one occasion he came upon an Egyptian overseer in the very act of cruelly punishing a helpless Hebrew slave. Moses slew the oppressor and immediately fled from Egypt.

In his flight he crossed the Red Sea and entered Midian, a province of Asia, bordering on Egypt. During his wanderings in Midian he did a kindly service to the seven daughters of Jethro, a wise priest of that country. Moses protected these maidens, who were tending their father's flocks, from neighboring shepherds who had offered them some rudeness. Jethro hearing of it hospitably received Moses into his family. Moses married Zipporah, Jethro's daughter, and tended the flocks of his father-in-law during forty years.

VOCATION OF MOSES. — It was in the eighty-sixth year of his age that God called Moses to free the Hebrews from the bondage of Egypt. Moses having led his flocks on one occasion as far into the desert as Mount Horeb, which is the northeast peak of Mount Sinai, God manifested himself to him in the burning bush and commissioned him to deliver his people.

Moses, conscious of the almost insuperable difficulty of the undertaking and diffident of his own powers for the successful accomplishment of such a mighty task, besought God to release him from the responsibility. But God encouraged him and promised to be his helper in all things.

Moses, by God's direction, associated with him in the undertaking his brother Aaron, who was eloquent and fluent of speech. It may be here remarked that Moses was more of a man of counsel and of action than of a flowery tongue.

With the assistance of God the brothers gained the entire confidence and hearty co-operation of the Hebrew people. Moses by his wisdom and miraculous powers won the esteem of the then ruling prince of Egypt, his ministers and courtiers. By his wonderful signs and prodigies he completely discomfited the Egyptian priesthood.

The brothers demanded of Pharaoh in Jehovah's name that he would allow the Hebrew people to go forth into the wilderness to offer sacrifice to their deity and celebrate their spring festival of the Passover.

Pharaoh refusing to grant the permission, God through Moses, made use of the plagues of Egypt to force the king into acquiescence.

These plagues were for the most part natural and customary visitations of the land of Egypt, but God, as is often his wont, made use miraculously of the natural phenomena to carry out his own wise ends.

These were the plagues employed by Moses: The turning of the waters into blood; visitations of frogs; gnats; flies; death of cattle; ulcers in men and beasts; hail and fire; locusts; darkness; death of the first born.

During the progress of each plague Pharaoh promised to let the Hebrews go, but on its cessation he rescinded this promise.

The tenth plague, the death of the first born, however, so terrified the Egyptians and Pharaoh that the Israelites were at last allowed to depart. On the morning after the passage of the destroying angel, every dwelling of the Egyptians had a dead body, from the palace to the poorest cabin. The descendants of Jacob had dwelt in Egypt for four hundred and thirty years, and in their exodus numbered 600,000 fighting men. The Egyptians were very reluctant to permit the Hebrews to go because they were of vast utility to themselves, being the veriest slaves and doing all the servile work of Egypt.

FLIGHT.—Apparently the Israelites departed for the wilderness to perform a religious ceremony required by their God and appropriate to the season, but they had their secret instructions from Moses that they were leaving Egypt no more to return, but to journey towards the land flowing with milk and honey that Jehovah had promised to their forefathers.

Canaan, their ancient heritage and the land of Jacob, was the object of their flight. Fearing to incur the hostility of the Philistines the Hebrews had to abandon the direct eastward road leading to Palestine and travel towards the southwest, which led them to the northern arm of the Red Sea.

ESCAPE.—Pharaoh after the departure of the Israelites, repented letting them go and pursued them with a great army, coming up with them on the shores of the Red Sea. Here again the Lord interposed to deliver his people and punish their persecutors. Moses miraculously divided the waters of the gulf of Suez forming the N. W. arm of the Red Sea, and the Hebrews gladly crossed to elude their pursuers. The Egyptians followed eagerly and had just attacked the escaping hordes of Israel, when the waters returned suddenly in great gulfs and swallowed up Pharaoh and his hosts.

JOURNEY TO SINAI.—Leaving the shores of the Red Sea the Hebrews entered the desert of Sur, where they suffered greatly from thirst and hunger and from wearisome marches and countermarches through the trackless desert. To add to their hardships they were fiercely attacked by the Amalekites, a predatory tribe of Arabs or Bedouins, whom, however, under the wise and skillful leadership of Moses, they succeeded in repulsing.

In his control and government of the Israelites, particularly in the early stages of their wanderings, Moses displayed the most extraordinary qualities of an organizer and leader.

To feed between two and three million of people in the wilderness was in itself no easy matter. Besides the Israelites had almost instantly passed from a condition of the most abject slavery to that of the wildest freedom. They were equally unfitted for self-government and undisciplined to repel the attacks of the war-like Bedouins that harrassed their marches. They had been half-brutalized by their bondage and the finer instincts of humanity were almost crushed in them. Their sense of gratitude to God and Moses for all that had been wrought for them was feeble and often entirely forgotten. Their murmurings and complaints were constant and they frequently broke into open rebellion against their leaders and expressed their resolution to return to the flesh-pots of Egypt.

Moses proved himself equal to every emergency, and though the meekest of men, could be firm and unbending when discipline required it. He proved himself the leader, legislator, ruler, judge, seer and father of his people. God through his instrumentality had wrought so many signal wonders that nothing could shake the people's faith and confidence in him.

SINAI.—In the third month of their flight from Egypt the Hebrews reached Mount Sinai and encamped around its base. Moses ascended the mountain to commune with God and receive the divine commissions for the people. On the third morning, the people being reverently assembled by the direction of Moses around the foot of the mountain, the voice of God was heard declaring his precepts. Nothing could be more awe-inspiring or sublimely impressive than the manner in which the commandments were announced to the people. Lightning and tempest and the rocking of the great mountain formed the prelude to their delivery.

Sinai is really a range of mountains, in Arabia Petræa, separated on the west from Egypt by the Gulf of Suez, and from a lofty peak of which, Jebel Musa (lat. 29° 20′ N.), God gave the commandments.

Moses again ascended the mountain for further communion with God and remained conversing with him for the space of forty days and nights. During the absence of Moses the Israelites forgot God and his new precepts so far as to fall into idolatry, making a golden idol and offering it divine worship after the manner of some Egyptians who had accompanied them in their flight.

Moses on his return was very much incensed at finding this condition of affairs. He severely rebuked the people for their crimes and ingratitude and sentenced a great number of the more guilty to death.

Priesthood and Tabernacle. — It is true that from the earliest times the Hebrews had some form of ceremonial law in their religious worship. Still before the advent of Moses they had no regular priesthood, the patriarchs and heads of families fulfilling the office and worshipping the Lord more or less after their individual tastes. Moses now, however, under Jehovah's direction, established a fixed ceremonial and a regular priesthood. God called the tribe of Levi to the priesthood, while the office of high priest was to be filled by Aaron and his descendants.

Neither did the Israelites have, hitherto, a fixed place of worship. Moses now resolved to build a rich shrine or tabernacle to be solely devoted to the services of the Lord. He constructed a shrine that was portable and could be borne about by the Israelites in their wanderings through the wilderness.

It was built of the most precious materials obtainable and was 45 ft. long, 15 feet wide and 15 feet high. The boards composing it were of hard fine wood and covered with plates of gold. The pieces could be taken apart, carried from place to place, and again easily replaced in position.

The sacred shrine consisted of two parts, the outer and larger part was called the

Sanctuary, and the inner and smaller part, the Holy of Holies. This beautiful tabernacle was adorned with the richest and choicest tapestry. At the entrance of the Sanctuary was hung a curtain of rich embroidery and another more precious curtain divided the Sanctuary from the Holy of Holies.

The ark of the covenant made almost of solid gold was placed within the Holy of Holies. The rod of Aaron, a vase filled with manna, the food of the wilderness, and the tables of the law were placed in the ark of the covenant. It was called the Ark of the Covenant because of its containing the tables of the commandments or the Old Covenant between God and his people.

The lid of the Ark of the Covenant, entirely of gold, was called the Propitiatory. On this lid were fastened two cherubim of beaten gold, facing each other.

A table covered with gold stood in the sanctuary on which were daily placed the unleavened loaves of proposition and a golden cup, filled with wine. The seven branched candlestick stood on this table, also, on which burned continually seven oil lamps. Before the table stood an altar of incense from which sweetest perfumes constantly arose.

A court to contain the people was formed around the tabernacle, in which was placed a brass altar of holocausts and a brazen laver for the priests.

FEASTS.—When Moses had occasion to consult the Lord on any grave concern he entered solemnly into the Holy of Holies and received God's answer from the Propitiatory. Moses, by God's command, prescribed the kinds of sacrifices, bloody and unbloody, to be offered, and also the times and manner of offering them.

Moses also, by the direction of God, instituted the Jewish feasts. The Passover in commemoration of the deliverance from Egypt; the feast of Pentecost in remembrance of the law given on Mount Sinai; and the feast of the Tabernacles, when the harvest was gathered in, to keep in memory the fact that their fathers dwelt in tents in the wilderness. Moses dedicated the tabernacle and consecrated Aaron the high priest of the Lord with the most impressive and gorgeous ceremonies.

DEATH OF MOSES.—From the base of Sinai the Israelites renewed their journey towards Canaan, the land of promise. God was so displeased with their murmurings, rebellions, infidelity and hardness of heart that he directed Moses to keep them wanderers in the desert for the space of forty years. From Sinai they passed into Kadesh (Phoran, Zin), East of Goshen in Egypt, and on the southern borders of Canaan, where most of those long weary years were spent. Moses, too, thought that it would be fool-hardy to lead an unorganized, undisciplined mass of freed slaves, such as the Hebrews really were, against the war-like tribes of Canaan.

During their sojourn in the desert Moses gradually educated and completely changed them into a new and great nation, so that when they finally undertook the conquest of Palestine, they were thoroughly equal to the task. Above all he had inspired them with such faith and trust in God, that nothing could resist their united zeal.

Towards the close of their forty years of wanderings Moses led the people into northern Moab, which he wrested from the Ammorite King, its then ruler. Apprising the Israelites of his approaching death, appointing Joshua as his successor and beseeching them to be faithful to God under all circumstances, he entered Mount Nebo to die. From the heights of Nebo he obtained his first and last glimpse of the distant Canaan, the land promised by God to the patriarchs, for which he had pined all his life. For a momentary diffidence, striking the rock twice, God punished him by denying him entrance into Canaan. He was buried in a valley in the land of Moab.

HIS CHARACTER.—There are few names, if indeed any, in history, sacred or profane, as towering as that of Moses. Like a great mountain peak it soars aloft and remains in solemn solitary grandeur, undimmed and undiminished by all the centuries. It has been too lofty to be reached or bathed by the mists and clouds of time.

He was the first to foster the growth of a national unity among the tribes of Israel and took advantage of the pressure of necessity to weld together the most diverse elements.

He heroically endeavored to make his people a truly religious nation, cultivating every noble virtue for Jehovah's sake and seeking God's aid in every great emergency of life. He attributed all his triumphs to God and did nothing of any moment without God's direction. He thus connected every greatness, every success, every noble achievement, every exemplary virtue with the name of God and the idea of religion.

HIS VIRTUES. — Under the pressure of every excitement and in all the supreme moments of danger he displayed calmness. This calmness was manifested in his dealings with Pharaoh, in the crossing of the Red Sea, and in the episode of the golden calf, when he returned from the mountain and found that even Aaron had yielded to weakness.

He was disinterested, attributing every triumph to God and claiming nothing for himself, and establishing the office of high priest in the off-spring of Aaron to the exclusion of his own sons and their descendants.

His patience was invincible. No cross, no trial, not even the unexpected could ruffle it. The seditions fostered by the jealousy of the elders and other unceasing vexations could not sour the unfailing sweetness of the temper of the "man of God."

He had perseverance. During all the opposition of Pharaoh and the desolate years of the wilderness he persevered in his aim to reach the promised land.

He had wisdom in council as he had fortitude in war.

He was the meekest of men. His name has ever been the Biblical synonym for meekness, and still he possessed the keenest energy and when occasion called for it the swiftest rapidity of action.

And notwithstanding his forbearing disposition he could be severe when God directed it and crime deserved it, as in the punishment of the guilty followers of Core, Dathan and Abiron, as also in the instance of the idolators at the base of Sinai.

JOSEPHUS.—"Now Moses lived in all one hundred and twenty years; a third part of which time, abating one month, he was the people's ruler; and he died on the last month of the year, which is called by the Macedonians DYSTRUS, but by us ADAR, on the first day of the month. He was one that exceeded all men that ever were in understanding, and made the best use of what understanding suggested to him. He had a very graceful way of speaking and addressing himself to the multitude; and as to his other qualifications, he had such a full command of his passions, as if he had hardly any such in his soul, and only knew them by their names, as rather perceiving them in other men than in himself. He was also such a general of an army as is seldom seen, as well as such a prophet as was never known, and this to such a degree, that whatsoever he pronounced, you would think you heard the voice of God himself. So the people mourned for him thirty days; nor did any grief so deeply affect the Hebrews as did this upon the death of Moses; nor were those who had experienced his conduct the only persons that desired him, but those also that perused the laws he left behind him had a strong desire after him, and by them gathered the extraordinary virtue he was master of. And this shall suffice for the declaration of the manner of the death of Moses." (Ant. IV. 8, 49.)

Chapter II.

THE PENTATEUCH.

Pentateuch is derived from the two Greek words πεντε, five, and τεῦχος, book, and is the name by which the first five books of the Old Testament are commonly known; the Jews, however, were wont to call them by the name, Torah, the law; or Torath Mosheh, the Law of Moses.

The books composing the Pentateuch are Genesis, Exodus, Leviticus, Numbers and Deuteronomy.

Genesis contains the history of the world's creation and its principal events to the time of the death of the patriarch Joseph, and is, with the probable exception of the book of Job, the most ancient of all books. Genesis carries us back to the very earliest ages of our race and covers a period of more than 2300 years and gives an account of man's fall, the genealogies, settlements, religion and destruction of the antediluvian earth; of its re-peopling, the call of Abraham and the rise and growth of the Israelites.

Exodus tells of the escape of the Hebrews from Egyptian bondage and closes with the relation of their encampment around Sinai.

Leviticus is a summary of the laws given the Israelites by Moses under the direction of Almighty God. It also treats of the sacrifices, religious festivals, the duties of the priests and Levites and the ceremonial worship of the Hebrews.

Numbers gives a census of the people of Israel and describes the march through the wilderness and the entrance into the land of Canaan. It embraces a period of 38 years and opens with the second month of the second year after the exodus.

Deuteronomy is chiefly devoted to a reiteration of the precepts of the law. It gives an account, too, of what took place in the wilderness during the eleventh month and the first week of the twelfth month in the 40th year of the wanderings of the Hebrews. With the exception of the last chapter, which gives an account of his death, it was written by Moses. This last chapter was written by Josue to serve as a transition to his own book.

Tradition.—The constant and unanimous tradition of the Jews and early Christians ascribe the authorship of the Pentateuch to Moses. It is absolutely certain that it could be the work of Moses alone, nor was its authenticity seriously disputed before the 17th century. In the time of Our Lord the Jews, of whatever religious or political complexion, universally ascribed the Pentateuch to the pen of Moses. The Pharisees, Sadducees, Scribes and common people were unanimously of this opinion. Nor could they have easily fallen into error concerning a work of so vast moment to themselves, embracing as it did the laws upon which their government and society rested. It was, too, the rule of their religious worship, as well as the recognized history of their race. All with the greatest unanimity refer the Pentateuch to the time when their society was formed and their religious ceremonial solemnly instituted, that is, to the time of their great law-giver and leader, Moses. Certainly the whole people collectively could not be deceived in so vital an affair. Christ and his apostles frequently refer in the New Testament to the Pentateuch, designating it as the law of Moses or the Book of Moses.

From the Pentateuch.—Not only do the tradition and universal consent of the Jewish race go to show the authenticity of the Pentateuch, but moreover the testimony of the work itself does the very same thing still more strongly if possible. It is repeatedly asserted in the Pentateuch that Moses is its author (Exod. XVII., 14;

Exod. XXIV., 4–7; Exod. XXX., 27; Num. XXXIII., 1–2; Num. XXXVI., 13; Deut. XXVIII., 61; Deut. XXIX., 20–27; Deut. XXX., 19; Deut. XXXI., 9–22–24.

PROFANE AUTHORS.—The Jews, following the precepts of their religion, in a great measure shunned all intercourse with the neighboring pagan and idolatrous nations. On account of this extreme exclusiveness it is not to be wondered at that they and their affairs were but little known to profane authors. Nevertheless many of such authors refer to Moses as the Jewish Lawgiver and Leader. Among others who do so may be named Diodorus Siculus, Athenagoras, Tatian, Tacitus, Dion Cassius, Juvenal, Celsus and Porphry; and Josephus mentions among Egyptian writers Manetho, Chæremon and Apion. There are really much stronger and clearer proofs from contemporary and succeeding authors that Moses wrote the Pentateuch than for the authenticity of the works of Plato, Aristotle, Cicero, Virgil and Livy. Constant and perpetual tradition have given the authorship of these works to the men whose names they bear, and the same argument should hold good in regard to the authenticity of the Pentateuch.

THE OLD TESTAMENT.—There are quotations credited to the Pentateuch in Machabees, Esdras, Nehemia, the Prophets, Kings, Judges, the Psalms, and indeed in all the books of the Old Testament from Josue to Hosea. Every history and writing of the Hebrew people quote from the Pentateuch and refer to it as familiarly known to all Jews.

Either the books of Josue, Nehemia, Esdras, Kings, and all the writings of the Jewish nation deserve no belief or the Pentateuch is the work of Moses. No mention except of him as its author has ever been made by any genuinely true Hebrew document.

Internal Evidence.—There is strong internal evidence in the Pentateuch to show that it is the work of Moses. No one else could have given to the book the impress of a diary, by which it is so clearly marked, jotting down all the items important either in his own individual or the national career, and only one standing in its very center could depict with such faithful and glowing colors the life that moved around him. The man alone could do it, who was in the midst of the events.

The author refers to the events, sermons and laws as being not only a witness of these things, but also a participator in them. The author touches on many things which Moses alone saw and describes them so exactly and with such minuteness of the circumstances of time, places and persons that only a writer contemporary with them could possibly so recount them. Many of the things written bar an author more recent than Moses. Some of the laws govern the conduct of the Israelites, while dwelling in the tents in the desert, others place them as not having as yet reached Canaan.

The very defect in the order of giving the laws shows a contemporary author, as a later one would have put them in a better order, placing together the laws relating to the same thing. The author of the Pentateuch, on the contrary, records the laws without regard to order or connection, jotting them down as they were given, together with a notice of the events which gave occàsion to them. The laws were written just as commanded and proclaimed.

Only the legislator himself could give such a detailed and at the same time so full an account of the law.

Every undertaking, journey, transaction, is described so accurately as to place and time as only could have been done by Moses. He speaks in it to the men whom he has led for many years, as one who has lived through all the events himself. The confused, abrupt and fragmentary character of the Pentateuch show it the work of

Moses, since a later historian would have wrought the mixed mass of personal, legal, historical and geographical material into a methodical and systematic whole.

No one writing after Moses could possibly have possessed the extraordinarily correct knowledge of contemporary Egypt and Arabia which appears throughout the Pentateuch. And this is especially true in his historical sketch of Joseph.

THE LANGUAGE.—The very language of the Pentateuch is a strong and direct argument of its authenticity. It is true that its language resembles very much that of the other books of the Old Testament because, in honor of Moses, it was held and revered by the Hebrew people during all the ages as their classic language. Every Hebrew writer aimed to imitate its style as closely as possible.

The Pentateuch, however, offers certain peculiarities of language of its own, such as the use of a common pronoun of the third person singular for both the masculine and feminine genders; the same term for boy and girl, and other very antique modes of expression, distinctly proving it to be a work of very much older date than any other portions of the Old Testament with the sole exception of the book of Job.

Harmony of Versions.—Another strong proof of the authenticity of the Pentateuch is the extraordinary concordance of the different versions or codices. The substance is certainly the same in all, no discordance of any moment is found between them. The work of transcribing the Pentateuch from parchment to parchment in ancient times was slow and laborious and one transcription occupied a lifetime. The great harmony between the versions is therefore most wonderful, and is due in a great measure to the fact that the ancient transcribers regarded their work with a religious sacredness.

Owing to the many transcriptions there may be some insignificant discrepancies in letters, punctuation and light words, but the integrity is untouched. The Greek version made three centuries before our era at Alexandria, the other Greek versions of the second century after Christ, and the Latin versions wonderfully agree substantially.

The Samaritans were at enmity with the Jews and rejected all the books of the Old Testament with the exception of the Pentateuch, which they have always preserved with the greatest care and veneration. Our version of the Pentateuch and that of the Samaritans agree most wonderfully in essentials. The Samaritan Pentateuch, with a very few characteristic alterations, is an accurate transcript of our Pentateuch, and this would have been an utter impossibility, considering the hostile relations between the Jews and Samaritans, if it had not been well known as a genuine document before the division of the empire.

HISTORICALLY TRUE.—What is related in the Pentateuch must be historically true. The tradition and consent of the whole Jewish people prove this. Moses could not have recorded as a fact some storied fable or grave falsehood without being contradicted by the Jewish people, who were witnesses of what he related. The book was preserved and guarded with the most jealous care and was kept in the ark of the covenant. Every seventh year it had to be read to the people in public. Certain priestly, sanitary and other laws required continual reference to it, so that certain portions of it were widely in use at an early period. It was necessary that every Synagogue, according to the law, should have a roll of the Pentateuch, written on parchment and certain portions therefrom read on the Sabbath and feast days.

The moral integrity of the author, who in a grave and simple style, relates events of which he himself performed the chief parts, great public events seen by all the people, commands the greatest faith; because they are told with the consent of the people who witnessed them, and are moreover attested by public monuments.

Moses, too, by the tradition of the Jewish nation enjoyed the greatest fame for his virtues, and his great integrity is easily gathered from the writings themselves. The style is grave and simple and so free from any sign of ostentation or art that truth itself seems mirrored in the sacred page.

The whole narration coalesces well together and all things look harmonious and consonant. Moses saw and witnessed with his own eyes most of what he relates, and the truth of what he recounts but did not witness is sustained by such indices as to remove all deception.

Monuments were erected, feasts instituted, and rites celebrated, in memory of the things done.

The Israelites had the greatest faith in its historical value and guarded it with the greatest care as a work absolutely true and inspired by God.

Moses not Deceived.—Moses was not deceived concerning the truth and historic value of the things related by him in the Pentateuch. He was educated with every care by Pharaoh's daughter and was thoroughly conversant with all the knowledge of that time and particularly with regard to the affairs of Egypt.

No man of his day could possibly have known as well and as accurately as he those things narrated by him in Exodus about the bondage of the Hebrews in Egypt. And the things related in the three later books were either performed by Moses himself or he was an eye-witness of them.

It was Moses who saw and heard God in the burning bush, stood before Pharaoh, led the people forth from bondage and inflicted the plagues on the Egyptians. It was Moses that guided the Israelites through the Red Sea, tarried with them forty years in the wilderness. It was Moses that received the Law from God on Sinai and promulgated it to the people. No better nor more capable witness to these facts could possibly be conceived of than Moses, who himself received the many instructions regarding these things from God and published them to the people. Moses could not be deceived in narrating these things in which he himself was the chief participator.

And although Moses was indeed not a witness of the things described by him in Genesis, still he could have obtained the knowledge of them in a most certain manner. The things which preceded the creation of man could only be known from divine revelation made either to Adam, the Patriarchs or Moses himself, whom God often favored with his conversation.

Those things which followed the creation of man Moses could ascertain from ancient traditions handed down in the families of the Patriarchs. This tradition embraced the divine revelations and divine promises made to the fallen race of man through the family of Abraham.

It was not very difficult for Moses to collect the truthful history of the times preceding his own, freed from all fiction, for according to the Hebrew text the space from his birth to the creation of man was scarcely 2400 years, and such was the long lives of the Patriarchs, that only six generations intervened between Moses and the creation of Adam. Moses easily learned from his father, Amram, the whole history of Joseph, Jacob and Isaac. And, moreover, such awfully impressive events as the Deluge, the building of the Tower of Babel, and the dispersion of the people could not easily be erased from the memory.

Again the vestiges of the Tower of Babel and the altars erected to God's service by the Patriarchs and of other things existed in the time of Moses.

Moses having written the greater part of the Pentateuch from what he himself saw and heard, could not have been deceived. And being so well versed in antiquities and so deeply learned in all the wisdom of the Egyptians, Chaldeans and Greeks, could not more easily be deceived concerning the things he derived from monuments and tradition than in the things of which he was a personal witness. He was thoroughly capable of distinguishing the true from the false.

Moses did not Wish to Deceive.—There is nothing in his writings that can lead even to the suspicion of fraud. His character and motives for acting and writing show him to be a sincere and honest witness and widely removed from all artifice and deceit.

Usually people are led to deception and fraud by a desire of their own gain or glory. Moses never studied his own glory or profit. He narrates to be sure the miracles he worked, the plagues of Egypt, the division of the sea, the drawing of water from the rock, which things, indeed, reflect glory upon him; but at the same time they indicate that he is only the instrument of God. And he ingenuously narrates how in working them he now and then failed in his faith due to God, and was consequently punished, among the penalties being his debarment from entrance into the promised land.

Neither did he try to prove a high antiquity and great name for his own family nor a glorious history for his country. On the contrary he tells that the Hebrews were still very few and abject when the neighboring nations, the Egyptians, Chaldeans and Canaanites, were already very flourishing.

He mentions the faults of his family and the people and refers to the Testament of Jacob, who heaps opprobrium on the tribe of Levi, from which he himself had arisen ; and the seeking of his own advantage was so foreign to him that he left his own sons among the common Levites and made Aaron high priest and Josue, of the tribe of Ephraim, the leader of the people. Everywhere in his life and speech he shows himself to be a man of the highest probity and of supreme candor.

There is no indication of fraud or falsehood anywhere. Eminent piety in God, a constant study of virtue, the highest patience and charity in bearing the contradictions of an ungrateful people are everywhere evident. He displays a most admirable ingenuity in narrating his own and his family's errors.

Moses never flattered the vices of men,

never sought the favor of the people, but rather imposed upon them the heaviest laws and hardest yokes. He often very severely reproached them with their rebellion, impiety and crimes. He never employed venal and fraudulent witnesses, but challenged the public faith and testimony of all the people. His style was simple, apt and full of modesty. He has everywhere shown himself a candid and truthful author and dissipated all suspicion of fraud, so that it is very apparent that he did not aim to deceive.

Besides the facts described in the Pentateuch were so public, so intimately coherent among themselves, so bound up with the lives and fortunes of the people of Israel, that it was an utter impossibility for Moses to deceive them even if he desired to do so.

All the Israelites were as familiar from tradition and other monuments with the historic matter of Genesis as Moses himself, and it was of extreme importance to them to preserve an exact knowledge of the things recorded in it because of their great interest to themselves, embracing the promises made by God to the Patriarchs. In fine all their hopes were reposed in it, and in it, too, the reason given even for their submission to the hardship of circumcision.

Neither could Moses deceive them in

what pertains to the historic matter of the other books: The plagues of Egypt; the crossing of the Red Sea; the giving of the law on Sinai; the Manna from heaven descending for forty years in the desert and feeding the people. All the people were witnesses to these things. If these alleged facts were but fictions Moses persuaded an innumerable multitude of people that they saw things they did not really see. He persuaded the Israelites that they had crossed the Red Sea when they did not cross it, that they ate Manna for forty years when they did not eat it, that they remained in the desert in which they never were, that they received the law from Moses when they did not receive it. It would be necessary to admit all this if Moses has falsely written.

Moses imposed hard laws on the Israelites, indeed most difficult of observance, claiming God as their author. On one occasion he punished with death a number of people who neglected a prescription of the law. The Israelites would never submit to such hardships from an impostor. Moses certainly could not have deceived the Hebrews in these matters, even if he wished to do so.

UNCORRUPTED. — The Pentateuch has come down to us entire and uncorrupted.

For the same public faith and tradition of the whole Jewish nation that through all generations proved the Pentateuch the genuine work of Moses prove also that it has come down to our time whole and uncorrupted. The whole nation was persuaded that it was the work of Moses, received from him by their fathers, neither was anything ever added to nor taken away by them of all the things written down by Moses.

Therefore, if this public faith and constant tradition invincibly prove the Mosaic authenticity of the Pentateuch, by an equal right they prove its integrity. And indeed no possible vestige of corruption has ever been or can be detected.

If the Jews wished to corrupt the Pentateuch, they would certainly eliminate those portions where they are upbraided for their lies, disobedience to God, crimes and impieties. But this clearly has not been done by them. Nor has the Pentateuch been interpolated by the Jews. They would not dare to do it. They held it in such supreme veneration that they would not under any circumstances dare to trifle with it. And even if they wished to corrupt the text, they could not successfully do so, for the Pentateuch was in the hands of all, was read every seventh year publicly to the people, the priests and Levites had charge of it. From this book was drawn the knowledge of all that pertained to the government of the Jewish public affairs, in it is described the whole public worship. Books so public could not possibly be manipulated by a few persons; and it would be utterly impossible for all the multitudes to consent to so grave a thing as its corruption.

Here is the testimony of Josephus: "For we have not an innumerable multitude of books among us, disagreeing from and contradicting one another (as the Greeks have), but only twenty-two books, which contain the records of all the past times; which are justly believed to be divine; and of them, five belong to Moses, which contain his laws, and the traditions of the origin of mankind till his death. And how firmly we have given credit to those books of our own nation is evident by what we do; for during so many ages as have already passed, no one has been so bold as either to add anything to them or take anything from them, or to make any change in them; but it becomes natural to all Jews, immediately and from their very birth, to esteem those books to contain divine doctrines, and to persist in them, and, if occasion be, willingly to die for them." (Flavius Josephus against Apion, 1–8.)

Thus tradition, the consent of the Jewish race, its own internal evidence, its language, the harmony of its versions, profane authors, its historic truth and the impossibility of its corruption, all bear testimony to the fact that the Pentateuch is the work of the inspired pen of Moses.

Chapter III.

INSPIRATION.

Inspiration is derived from the Latin, Inspiratio (in, in, and spirare, to breathe), and literally signifies the act of breathing in or infusing. Webster defines it as: " Specifically, a supernatural divine influence on the prophets, apostles, or sacred writers, by which they were qualified to communicate moral or religious truth with authority; a miraculous influence which qualifies men to receive and communicate divine truth. '*All Scripture is given by inspiration of God.*' 2 Tim. III, 16."

In connection with the Holy Scriptures inspiration means a supernatural influence of the Holy Ghost upon an author, moving him to write and so directing his mind while he writes that he cannot err. He pens only the things which God wills and hence his writings may be truly said to be the word of God.

Inspiration is then an act of God moving the will of the writer and impelling him to write, directing him while he writes, as well in the choice of the material as in its disposition, so much so that he pens precisely what God wishes him and nothing more, even though other things may have been divinely revealed to him or may be most certainly known to him from other sources.

In inspiration the motion of the will to write, and the enlightening of the intellect, by which both errors are avoided and unknown truths revealed which God wishes to disclose, are distinctly required.

By this enlightenment the light of natural reason is not destroyed, but divine light is infused, the intellect is so perfected that without danger of error it knows these things which by natural means came to its knowledge, and is able to perceive those things which were previously inscrutable to it. The intellect can be illuminated by God in various ways; through revelation as in ecstasy, through the imagination, as often happened to the prophets, or by speech, or by external vision, or by internal revelations in dreams. And this illumination is given to the writer either of things previously unknown to him, as in the case of the prophets, or he is simply directed in a choice of things, and rendered free from error in reciting what is otherwise known to him when a special revelation is not necessary.

This supernatural motion of inspiration does not take away or even impair the free will of the writer. The liberty of the writer remains under inspiration, as the prophet's under the gift of prophecy and man's under efficacious grace. That motion does not exclude natural media, but adds to natural causes as the will is carried or exalted to the supernatural order.

Therefore the inspired writer is not free from the labor which every writer sustains in writing: "And as to ourselves indeed, in undertaking this work of abridging, we have taken in hand no easy task, yea rather a business full of watching and sweat." (II Mach. II, 27.) "Forasmuch as many have taken in hand to set forth in order a narration of the things that have been accomplished among us: according as they have delivered them unto us, who from the beginning were eye-witnesses and ministers of the word: it seemed good to me also, having diligently attained to all things from the beginning, to write to thee in order, most excellent Theophilus." (Luke I, 1–3.)

The simple assistance of the Holy Ghost does not suffice for inspiration; something more is required, some excitement or impulse of the Holy Spirit.

There must be suitable testimony to show that a writer was inspired. It will not suffice for the author himself to assert it, for he may be deceived. We must have such testimony as cannot possibly lead us into error or be impugned. Such as the testimony of Christ, His Apostles, the Church, the Holy Fathers or the unanimous consent of all of these.

The mere assistance, "assistentia," of the Holy Ghost must be distinguished from inspiration. Inspiration is something positive, whereas this "assistentia" is a merely negative idea. The ecumenical or general councils of the church have had the assistance of the Holy Ghost to protect them from error, and still they are not classed with the inspired writings.

A special impulse of the Holy Ghost to write and also to write on particular subjects over and above protection, is required for inspiration.

A distinction must be also made between revelation and inspiration. In revelation God reveals to a person truths unknown before, without moving that person to commit the things thus revealed to writing.

The inspired writer on the other hand has received the impulse to write and is directed by divine influence in his work, but it is not necessary that any unknown or new truths be revealed or communicated to him. It is probable, for instance, that the author of the book of Esther required no revelation, as he could have known everything therein contained from ordinary channels.

Again, revelation need not necessarily be committed to writing; it can be transmitted to posterity by the living voice through tradition; inspiration, however, regards writings altogether.

A work composed by mere human industry and afterward declared by the Holy Ghost through the mouth-piece of the church to be free from error cannot be said to be inspired. A work of this kind cannot be regarded as inspired, however perfect it may be and however free from error, because the Holy Ghost had no special connection with its origin. There is wanting the impulse of the Holy Ghost to write, and His supervision while being written, the Holy Ghost merely approving it when already finished.

According to some exegetists in those historical portions of the Scriptures where the sacred penman relates facts already known to him either as having himself witnessed them or learned them from perfectly reliable testimony, inspiration requires only a simple superintendence of the Holy Ghost to guard against mistake in detailing such facts. This opinion, however, falls short of what is required for inspiration. The claim here for inspiration is no stronger than for the decrees of the general councils which, although not considered inspired, still have the assistance of the Holy Ghost to secure them from error. The whole substance of the Scriptures must have been suggested by the Holy Ghost, even where the subject was already known to the author. Where the matter was already known to the writer a simple suggestion of what he should write suffices; revelation only being necessary when there is question of something previously unknown to him.

It may be said that the mode, degree and extent of inspiration are all subjects of dispute. The church has here passed no judgment and only claims that the canonical books are all and in every part inspired.

The advocates of *plenary* inspiration assert that every verse, word, syllable and letter of the Bible is the inspired and the direct utterance of the Most High. The sacred penmen were as pieces of mechanism moved by the fingers of God. Their different styles or modes of expression are to be regarded as only different tones of the same musical instrument produced by one only artist. Accordingly God is everything in the Scriptures, and the writers merely passive vehicles. The words of Holy Writ are as much the divine language as if God himself spoke them in His proper person. The differences found in the sacred books arise from no individual quality of the writer, but flow from the diverse aims and uses with which they are employed by the Holy Ghost.

Hence it is contended that inspiration is intermitting, so that the divine afflatus seizes the soul at certain moments and at others abandons it. Thus for instance the words of St. Paul ordinarily may not have possessed any special authority, while his epistles on the other hand must be looked upon as inspired. Plenary inspiration claims that the Scriptures are faultless in form, essence, spirit and letter; and perfectly divine and accurate in morals, dogma, history and narrative.

Again, many exegetists of very great authority contend for the VERBAL inspiration of the sacred Scriptures, claiming that the individual words are the subject of inspiration.

Another opinion, held by Saints Augustine, Jerome and Alphonsus and said by Libermann to be the common opinion of theologians, is that the very words have not been inspired, but only the sense and substance, particularly in the moral lessons and in the historical and narrative parts of the Sacred Books. This is the safest and strongest ground upon which inspiration can be maintained. Nor is this opinion in any way derogatory to the dignity and authority of the Bible as an inspired book.

The advocates of verbal inspiration encounter great difficulties in defending their position, which this opinion at once removes.

This view of inspiration would account for the necessity, of which the sacred writers were convinced, of using care and diligence in their work, and why the author of the II Machabees asks pardon for his defects in style. This view is also perfectly consistent with the fact that the Bible is a mass of documents of different authors and of great antiquity and its text, owing to the great number and human frailty of amanuenses, has undergone the usual changes attending the transmission of historical documents, and marked by the usual inequalities and varieties of style that we meet with in any other collection of ancient literature, and presents in many cases peculiar difficulties and differences in details, and scientific and historical errors, and even contradictions in slight and trivial matters not connected with the spirit or substance of the general narrative, and this is particularly applicable to the New Testament in its quotations from the Old.

These trivial inaccuracies in no way invalidate the substantial veracity of the sacred Scripture. They are indeed really but a most striking witness to its truthfulness. They show that trifling indeed are the faults discerned in this wonderful book by the awful microscope of a thousand years of criticism. Such slight discrepancies are the mere freedoms which writers, thoroughly honest, and animated with a high interest that overlooks trifles, permit themselves.

Still they must be recognized as human imperfections that have crept into the sacred text and go to prove that the very word of the Bible cannot, without grave difficulty, be regarded as inspired.

The mere reading of the sacred Scripture irresistibly impresses one with the fact of its inspiration. It bears its own divine witness and its meaning shines forth with a divine power and lustre, such as invest no other book. The efficacy and sublimity and heavenly truth of doctrine, majesty of style, harmony of parts, wonderful preservation and miraculous effects show impressively the hand of God.

The Bible is a message from God to Man. The letter or word is nothing, the meaning is everything. The divine spirit in the Bible makes itself felt, shines out in every page of it; and this is inspiration in the highest sense, the mind of God meeting our minds in the sacred text, enlightening, guiding, elevating, purifying them.

But if we admit slight errors in the Scripture, why may it not all be imperfect or erroneous? The sufficient answer is that it is not so, that judged by the very same critical tests which detect such errors, the Bible remains an entirely unique and essentially perfect book.

In the Bible itself there are many passages claiming for it inspiration, such as Exod. XVII, 14; Jer. XXX, 2; Habac. II; Daniel XII, 4; Deut. XXXI, 19; Ezech. XXIV; I Paral. XXIX, 29; II Paral. XXVI, 22.

The Jews universally believed in the inspiration of their scriptures as is very evident from many witnesses, among others Philo and the Thalmud, and particularly from the testimony of Josephus: " Because every one is not permitted of his own accord to be a writer, nor is there any disagreement in what is written; they being only prophets that have written the original and earliest accounts of things as they learned them of God himself by inspiration; and others have written what hath happened in their own times, and that in a very distinct manner also.

For we have not an innumerable multitude of books among us, disagreeing from and contradicting one another (as the Greeks have), but only twenty-two books, which contain the records of all the past times; which are justly believed to be divine; and of them, five belong to Moses, which contain his laws, and the traditions of the origin of mankind till his death. And how firmly we have given credit to those books of our nation is evident by what we do; for during so many ages as have already passed, no one has been so bold as either to add anything to them or take anything from them, or to make any change in them; but it becomes natural to all Jews, immediately and from their very birth, to esteem those books to contain divine doctrines, and to persist in them, and, if occasion be, willingly to die for them." Josephus against Apion, I, 7–8.

Our Lord bears testimony to the inspiration of the Old Testament: Matt. V, 18; John V, 46; Luke XXIV, 27; Luke XXIV, 44.

The Apostles have in many places praised the Old Testament and given its authorship to God: Act. III, 18; Rom. I, 2; II Pet. I, 21; Rom. III, 2; II Tim. III, 15.

But the real proof for the Inspiration of the Bible is the infallible testimony of the Church. It can be clearly shown that the Church has always taught the Inspiration of the Scriptures.

The holy fathers bear witness to the teaching of the early church regarding the belief in inspiration. It would be an endless task to quote from their works concerning their faith in inspiration, as they may be literally said to be a unit on this point.

St. Clement of Rome in Sec. 13 of his first epistle to the Corinthians, St. Polycarp in his epistle to the Ephesians; St. Justin in his Apology, St. Irenæus in the 47th Chapter of his second book against Heresies, St. Clement of Alexandria, Origin, St. Cyprian, St. Athansius, St. Augustine, Athenagoras, Theophilus, Tertullian, Gregory Nazianzen, Cyril of Jerusalem, St. Chrysostom, St. Ambrose, St. Hilary, St. Gregory the Great and Theodoret speak of Biblical inspiration.

Subsequent to the time of the fathers the church has manifested her teaching concerning the inspiration of the Bible by her general councils. This is more particularly true of the decrees of the fourth session of the Council of Trent. And although she has not passed judgment upon the manner or extent of inspiration it has been ever her public and unanimous sense that the sacred Scriptures have been divinely inspired in their every part as in their entire contents.

The Church could not err in teaching that the Scriptures are inspired because her founder, Christ, promised her the guidance of the Holy Ghost and that she could in no way fail or fall into error in her teachings. She cannot hence err in teaching the inspiration of the Bible for this is a matter of grave importance, indeed a matter of faith. Hence the Church cannot err in teaching the inspiration of the Sacred Books.

Nor is this arguing in a vicious circle, as some critics claim. They say that we prove the inspiration of the Bible by the infallible authority of the Church, and the infallibility of the Church from the inspiration of the Bible. This is not true. We first take the New Testament as a historic record without in the least attributing to it inspiration. We regard the evangelists simply in their character of true and honest historians. The miracles they record prove the divinity of Our Lord, that He was truly the Son of God, the promised Messiah.

He established a Church and promised to be with her all days even to the end of the world, and that the gates of hell should not prevail against her, in a word, he promised her infallibility in her teaching.

This infallibility being thus established she cannot fail in her doctrines and so cannot err in teaching the inspiration of the Sacred Books.

Chapter IV.

SOME DIFFICULTIES SOLVED.

Elohim and Jehovah.—During the last few centuries the authenticity of the Pentateuch has been often called into dispute. Critics have denied to Moses its authorship on one ground or another. They were moved to this by various motives. Some attacked its authenticity to show their exegetical acumen, some to display their knowledge of Orientalism and others to gain notoriety by connecting their name with a work so immortal and imperishable.

It would be an absolute miracle to have the authenticity of a work of its momentous interest pass unchallenged.

The authenticity of every great literary work has been at one time or another disputed. Shakespeare is but a few hundred years dead, and his very existence has been denied. His great work has been credited to many authors. One critic, even, has asserted that he had discovered a cipher in the work itself, giving its authorship to Francis Bacon.

In the earlier chapters of Genesis God is called Elohim (Almighty), and in the later, Jehovah (Everlasting). From this it is declared by some critics that the Pentateuch was compiled by an author much later than Moses, principally from two very ancient documents called the Elohistic and Jehovistic. The simple fact that God was called by different names in different parts of the Pentateuch would not militate against its Mosaic authenticity. There is no reason why the same author could not have called God by different names in different places in his work. Moses, in composing his work, might have employed some very ancient manuscripts. In these God might have received different appellations by the different authors, and Moses might have retained through courtesy the names used by these predecessors.

To-day we give God a variety of names, the Almighty, Divine Providence, Infinite Goodness and many others.

Nor is Elohim confined entirely to the first part of Genesis and Jehovah to the last, the terms are frequently interchanged; in the account of the Deluge Jehovah is used in the eighth verse of the sixth chapter, and in the first and fifth verses of the seventh chapter. Both names are used in the sixteenth verse of the seventh chapter. Also in the narrative of the sacrifice of Isaac, Elohim is used first and Jehovah shortly after. The names are also used alternately in the history of Joseph and in the exhortation of Moses to the people in Deuteronomy.

Esdras. — Many Rationalists give the authorship of the Pentateuch to Esdras, claiming that he compiled it from the Elohistic and Jehovistic documents already mentioned. The Elohistic document is said to come down from a very ancient author, who gave to God the appellation of Elohim and the Jehovistic from one who gave Him the name of Jehovah.

But if Esdras had himself compiled this work, which contains so many rites and institutions, including their whole life, as well civil as domestic, so intimately connected with religion, and which also contains so many reproaches and threats and which imposed such a hard yoke upon them, how could he then for the first time persuade the Jews to accept it all upon his sole assertion if never heard of before?

If Esdras composed these books, it certainly was after the return of the Israelites from captivity; but long before this time the Jews had the Pentateuch, for the priests and levites were already established in their office. Besides Esdras himself testifies to a prior existence of the book of Moses. (1 Esdr. III, 2; 1 Esdr. VI, 18.)

Long before the captivity, Jeremiah alludes to the Law of Moses, under which name the Pentateuch is always designated in the Old Testament. The Samaritan Pentateuch, moreover, existed long previously, so that Esdras could not have composed the Pentateuch from Elohistic and Jehovistic documents.

The spirit, tone, language, and all those smaller peculiarities of the Pentateuch already mentioned prove the utter improbability of the authorship of Esdras; and besides he never could have been able to avoid so skillfully his own individual manner and style, as it appears in his own book.

HELCIAS.—Other Rationalists place the composition of the Pentateuch in the time of King Josias, and endeavor to establish this opinion from things narrated in the books of Kings and Paralipomenon, that a volume of the Law was found in the temple by the high priest Helcias. It was desired, they say, to move the King and people to penance by the reading of this book, which could not have been known before, they assert, because it did not previously exist. But just the very contrary appears from the narration itself. In the 18th year of the reign of Josias, when builders were restoring portions of the temple, Helcias the high-priest found a book of the Law in the House of the Lord, and said to the scribe Saphan, "I have found a book of the Law in the House of the Lord," and gave it to him. He took the volume to the King and related the circumstance to him. The King read it and was moved to penance and he brought together in the temple the priests, levites and all the people and had the volume read to them. It had a great effect upon all, moved them to observe the precepts and and ceremonies contained in the book and particularly caused them to renounce idolatry. "And in the eighteenth year of King Josias, the King sent Saphan, the son of Aslia, the son of Messulam, the scribe of the temple of the Lord, saying to him: Go to Helcias, the high-priest. . . . And Helcias the high-priest said to Saphan, the scribe: I have found the book of the Law in the house of the Lord: and Helcias gave the book to Saphan, and he read it. And Saphan the scribe came to the King, and brought him word again concerning what he had commanded. . . . And Saphan, the scribe, told the King, saying: Helcias the priest hath delivered to me a book. And when Saphan had read it before the King, and the King had heard the words of the book of the Law of the Lord, he rent his garments. And he commanded Helcias the priest, and Ahicam, the son of Saphan, and Achobor, the son of Micha, and Saphan the scribe, and Asaia the King's servant, saying: Go and consult the Lord for me, and for the people, and for all Juda, concerning the words of this book, which is found: for the great wrath of the Lord is kindled against us, because our fathers have not hearkened to the words of this book, to do all that is written for us." (IV Kings XXII. 3, 8, 9, 10, 11, 12, 13, 14.)

This narrative does not in any way impugn the Mosaic authenticity of the Pentateuch. It does not presume to say that Helcias composed, but found the book, so that, certainly, it must have existed previously. A new book just then found and heard of for the first time could not have moved the people in this manner. This effect on the people proves the genuineness of the book, that it must have had the authority of Moses and so of God himself to be able to thus move the people from idolatry.

Before the time of Josias all things contained in the Pentateuch were most perfectly known. Frequent references being made in the Prophets, Kings, Judges and Josue to the laws, facts and miracles recorded in the Pentateuch.

That Helcias should have been the real author of the Pentateuch, as these Rationalists assert, would imply a complicity in forging the book, not only on the part of Jeremiah, the prophetess Holda, and the elders, but almost of the whole people, among whom, on the contrary, there certainly seems to have been living a very vivid tradition of the former existence of the Pentateuch. Moreover, had it been first written in those days, there would certainly have been introduced into it a pedigree and origin of the House of David, differing from the incestuous one given in Genesis. Deuteronomy would have changed its language considerably about Royalty; and Joseph's would not have stood out so prominently as a favored tribe.

Moses in the Pentateuch speaks of himself in the third person, but this is no unusual thing for an author writing about events of which he himself formed the chief part. Cæsar, Xenophon, Esdras, Mathew, John and Josephus have done the same thing.

That Moses called himself the meekest of men was not in a spirit of boasting, but to show that the chastisements which he inflicted were not prompted by anger or revenge, but by justice and God's command, and if he sometimes mentions his virtues he does not forget to also name his faults.

At the close of the Pentateuch reference is made to the death of Moses, but this part is taken from the beginning of the book of Josue, with which it was formerly joined.

It is claimed that a portion of Deuteronomy was written after the Israelites reached Canaan, from the use of a preposition which seems to signify beyond: "These are the words which Moses spoke to all Israel beyond the Jordan." The Hebrew preposition used in the text can be rendered by either beyond or on this side (transvel citra), and evidently regards the bank of the Jordan and has no reference whatever to Canaan.

Apparently there is a mistake in chronology between Esau and Saul, but this arises from the mention of the leaders of tribes who flourished simultaneously and not successively.

Many names of places are found in the Pentateuch, which are said to have been given to them only long after the time of Moses. The mention of the city of Dan, so called only after the conquest by that tribe, and the enumeration of towns built or enlarged by the tribes of Gad and Reuben, which could not have happened in the time of Moses, are cited particularly as instances of this.

These towns or villages may have all existed in the time of Moses, but under other names, and the commentators and transcribers for the sake of clearness have used and inserted the names under which these places were known in their own day.

The author speaks of the institution of the Levites and uses the expression "up to this day," and others similar, "Now the Canaanite was at that time in the land;" "and at that time the Canaanite and Pherezite dwelled in that country." Moses could as well speak in that way as St. Matthew could say (XXVII, 8,) "For this cause that field was called Haceldama, that is, the field of blood, even to this day."

There are some fifty passages contained in the Pentateuch, which would appear to place the writer later than the time of Moses. These are, however, evidently the work of annotators and transcribers. Things have crept into the original text in this way by interpolation. Many things may have been added by way of commentary, note or explanation, first written on the margin and afterwards embodied and incorporated into the text. This can be conceded without injury to the real substantial Mosaic authenticity. These notes have been added from time to time by annotators for the sake of clearness and particularly in regard to obsolete words or old towns with new names. This has frequently happened in regard to the works of the great profane authors without in the least thereby injuring their title to authenticity, neither should it be regarded as in any way detrimental to the Mosaic authorship of the Pentateuch.

The Pentateuch was composed by Moses in the nature of a diary. He dotted down things as they struck him at different times. He may not have always strictly regarded the chronological order of events, and may have dotted down the same things at different times and under different circumstances, in different words and phraseology, and so have made repetitions.

Such is the character of a diary. The finding of repetitions in the Pentateuch does not argue different authors any more than the repetition of the account of the conversion of St. Paul argues several authors for the Acts of the Apostles.

That the style is at one time concise and at another profuse, and the language of unequal flow is not against the authorship of Moses. The Pentateuch appears to be made up from fragments, because Moses consulted different sources for his information, particularly in writing Genesis. Diversity of style was caused by diversity of times and things. His style in the prime of manhood must have naturally differed from that of his old age. He must have also used one style in describing laws and another in exhorting and threatening the people.

That the numbers of the people and the cattle do not in places seem to conform to the laws of natural increase or even to what the geometrical limitations demanded, and other seeming contradictions that show themselves in the Pentateuch, are merely apparent difficulties, as can be easily shown.

Dr. Davidson gives as a reason that Moses did not write the Pentateuch, that he was emphatically a law-giver and an actor, and not a historian. Cæsar was a legislator and actor and still he wrote his Commentaries. Grant was an actor and emphatically no talker or writer, and yet he has given us his Memoirs.

Moses may not have intended to write a history of his times, but the matter of the Pentateuch was furnished by his pen, and no vicissitude of time or effort of critic will take from its character as the Diary of Moses.

Some of the most serious difficulties urged against the Pentateuch, and indeed the Bible, are proposed by the votaries of what is known as the "Higher Criticism." This is the latest and most insidious method of criticism and hence the following chapter will be devoted to its consideration.

Chapter V.

THE HIGHER CRITICISM.

Three different methods of criticism have been used to combat the inspiration of the Bible and eliminate the supernatural from its pages. The first method was to explain away the miracles of the Scripture in a natural manner; to reduce the seemingly miraculous to the merely marvelous; and the predictions of the inspired prophets to shrewd but vague forecastings on a par value with the prognostications of our own weather prophets. In fact, this method undertakes to furnish a human key for the solution of all Biblical mysteries.

The Star of Bethlehem was for instance a natural conjunction of Jupiter and Saturn. The dividing of the waters of the Red Sea was occasioned opportunely and without any supernatural intervention by the blowing of a high wind and the restoring to their place of the waters that engulfed Pharoah and his cohorts by the ceasing of the storm.

The prophets were merely very sagacious statesmen, who foretold in highly poetical language future events from their keen observations of the course of things in the past.

The German Rationalists, represented by Paulus and Eichhorn, adopted this method. The genuineness of the books of the Bible was not in the least assailed, but their inspiration and supernatural character were completely impugned.

The second method of criticism is to deny absolutely the veracity and good faith of the writers of the sacred books. The critics of this class assert that the Bible miracles were impositions and the prophets conscious frauds. They scoff at the supernatural, declare all religion a fraud and designate the faithful believers as the dupes of a selfish, designing and interested priesthood. Voltaire, Thomas Paine and Robert Ingersoll are the color-bearers of this critical school. These are the most shallow of all the critics. Their knowledge of the Bible and of science is both superficial and limited. Their weapons are raillery, chicanery and sneering.

The third method is that of the so-called higher criticism, which denies the genuineness of the sacred books. This system acknowledges the honesty and sincerity of the writers of the sacred volumes and confesses that they meant to affirm that miracles were really performed and prophecies uttered. These critics claim, however, that a great length of time had elapsed between the recording of the miracles and their alleged occurrence. That they are not attested by contemporaries and eye-witnesses, but by persons living long subsequently, and that the prophecies were not committed to writing until after their fulfillment. Hence legends and fictions from long repetition had been formally received as absolute truths and the writers simply transmitted the mistaken belief of their own times.

The real aim of this criticism is to show that the age and authorship ascribed to the sacred volumes are not correct and must be referred to an origin altogether different from that heretofore claimed for them.

Wellhausen, Kuenen and Duhm may be cited as fair representatives of this modern school of criticism. According to professor Julius Wellhausen the Pentateuch or Hexateuch, as he prefers to call it, as embracing the Book of Josue, in its present form, is the result of a post-exilic sacerdotal movement tending to substitute what he calls the "priestly code" for the primitive institution, with the object of offering under the prestige of antiquity an effectual resistance to national disintegration. The theory is based upon an analysis of the Pentateuch legislation, in which he finds the more distinctive sacerdotal enactments attributed to Moses to be more recent, both in language and character, than the rest of the legislation, and in some cases incompatible with it.

That the books of the Pentateuch are of a heterogeneous character; are in part reproductions of older documents; that there would seem to have been an interest involved in, and an opportunity given for, their late invention; do but constitute at most a suspicion based upon a probability, which those who have grounds of credence distinct from the intrinsic character of the document may be permitted to put aside.

The great thing about Wellhausen is his imagination. He has a wonderfully exuberant fancy which has enabled him to produce histories devoid absolutely of a single fact that ever positively existed.

The authorship of Moses is impugned because he speaks of himself in the third person. But Isaiah (VII, 3), Jeremiah (XXXVI, 4), Hosea (1, 2), and the Evangelist John (XIII, 23), and Matthew (IX, 9) do the very same thing without the slightest suspicion of injuring thereby the genuineness of their authorship.

The authorship of Moses is also called in question because in (Num. XII, 3) he says of himself: "For Moses was a man exceeding meek above all men that dwelt upon earth." Moses here draws attention to his great meekness from no spirit of boastfulness or vain-glory, but with the same impartiality with which he names his drawbacks, such as the disobedience which excluded him from the Promised Land and his neglect to circumcise his child.

In a like spirit St. Paul says of himself: "I labored more abundantly than they all," and St. John styles himself: "The disciple whom Jesus loved."

It is claimed that Deuteronomy was written in the reign of Josiah or very shortly before. Wellhausen says (Brit. Ency. Vol. XVIII, page 508): "That the author of Deuteronomy had the Jehovistic work before him is also admitted; and it is pretty well agreed that the latter is referred, alike by the character of its language and the circle of its ideas and by express references (Gen. XII, 6, XXXVI, 31, XXXIV, 10; Num. XXII; Deut. XXXIV, 10), to the golden age of Hebrew Literature, the same which has given us the finest parts of the books of Judges, Samuel, and Kings, and the oldest extant prophetical writings,—the age of the kings and prophets, before the dissolution of the sister states of Israel and Judah."

How under any possible shadow of verisimilitude can Deuteronomy be referred to the age of Josiah when it is filled with injunctions to exterminate the Canaanites (XX, 16 – 18) and the Amalekites (XXV, 17 – 19) who had ages before disappeared?

Laws are not framed to regulate a state of things which have long passed away, and can never possibly be revived. At the period in which the code of Deuteronomy is claimed to have been composed, about the time of Josiah, the Jews were hard pressed to repel the incursions of Egypt and Babylon, and it certainly would be utterly absurd to enact a law contemplating foreign conquests as in (Deut. XX, 10 – 15); and another favoring Edom (Deut. XXIII, 7 – 8) against Moab and Ammon (XXIII, 3 – 4) would precisely suit the time of Moses, but not that of the Kings.

About the time of Josiah the prophets were struggling hard to dissuade the people from forming any association with the Egyptians (Isai. XXX, 1, XXXI, 1; Jer. II. 18), whereas in (Deut. XXIII, 7) there is a strong command given to them to maintain friendly relations with the Egyptians.

The references in Deuteronomy to Egypt

imply a recent residence in it, the Egyptian bondage and deliverance from it are cited as motives of gratitude to the Lord, (Deut. XIII, 5; XX, 1; Lev. XIX, 36; XXVI, 13; Num. XV, 41; Deut. VII, 15; XXVIII, 60.)

If anything could serve to show the supreme absurdity of referring the Deuteronomic code to the time of Josiah it is that while (Deut. XVII, 14) contemplating the possible selection of a king in future, the code makes not the slightest allusion to an actual kingly government, but places the supreme executive authority in a judge and the priesthood (Deut. XVII, 8–12; XIX, 17); declaring that the king must be a native and not a foreigner (Deut. XVII, 15), when already for ages before Josiah's time there had been a long line of kings, with the succession firmly fixed in the family of David.

Deuteronomy also demands a promise from the future king before he can be selected that he will not "cause the people to return to Egypt," (Deut. XVII, 16); as they appeared desirous to do in the days of Moses on every fresh grievance (Num. XIV, 4), but which they never thought of doing after their possession of Canaan.

Wellhausen, to show that the Pentateuch is a tissue of broken fragments demanding many authors, claims that the first legislation, as he calls it, presupposes a plurality of sanctuaries, and that Deuteronomy, on the other hand, has a law for the abolition of local sanctuaries, as they are recognized by the first legislation. To show that the altars are many, and not one, he cites Exod. XX, 24, 26: "You shall make an altar of earth unto me, and you shall offer upon it your holocausts and peace-offerings; your sheep and oxen, in every place where the memory of my name shall be: I will come to thee and will bless thee, etc." This, Wellhausen maintains, is in direct contradiction to Deut. XII, 2, 3: "Destroy all the places, in which the nations that you shall possess, worshipped their gods, upon high mountains, and hills, and under every shady tree. Overthrow their altars, and break down their statues, burn their groves with fire, and break their idols in pieces: destroy their names out of those places." He claims that this latter must have been written in the time of Josiah, who wished to abolish all the ancient sanctuaries and establish at Jerusalem a single one for the unification and centralization of Israel.

Wellhausen puts an entirely wrong construction on this second passage. It refers to heathenish altars and not to Jewish sanctuaries.

The first passage is the primary law of the altar of Israel, given at Sinai, before even the tabernacle was built. It directs the erection of an altar of stone or earth in every place where God should record his name or manifest himself, but not at all whereever people might select to erect such an altar. This was the motive for the erection of an altar at Sinai and other future places where God had conspicuously made a manifestation of His being. The passage really refers to altars successively erected at different places in the Wilderness, and not co-existing sanctuaries in Canaan. No sanction is here given for a multiplicity of co-existing altars. Abraham, Isaac and Jacob in patriarchal days and in the Holy Land itself, built different altars and offered sacrifice upon them, but they were erected in their several abodes successively but not simultaneously. They were not rival but successive altars.

Wellhausen pretends to find a serious discrepancy between Deuteronomy and the Levitical Law in regard to the priesthood; in this that according to the former all Levites are priests, and have an equal right to perform priestly functions and share the priestly revenues, while in the latter none are priests but Aaron and his sons, and the Levites are servants or attendants upon the priests.

The abolition of the local shrines in favor of Jerusalem, Wellhausen argues, necessarily involved the deposition of the provincial priesthood in favor of the sons of Zaodoak in the temple of Solomon. The law of Deuteronomy tries to avoid this consequence by conceding the privilege of offering sacrifices at Jerusalem to the Levites from other places; Levites in Deuteronomy is the general name for priests whose right to officiate is hereditary. But this privilege was never realized, no doubt because the sons of Zaodoak opposed it. The latter, therefore, were now the only real priests, and the priests of the high places lost their office with the destruction of their altars; for the loss of their sacrificial dues they received a sort of eleemosynary compensation from their aristocratic brethren (2 Kings XXIII, 9).

The displacing of the provincial priests, though practically almost inevitable, went against the law of Deuteronomy; but an argument to justify it was supplied by Ezekiel (Ezek. XLIV). The other Levites, he says, forfeited their priesthood by abusing it in the service of the high places; and for this they shall be degraded to be mere servants of the Levites of Jerusalem, who have not been guilty of the offense of doing sacrifice to provincial shrines, and thus alone deserve to remain priests.

If we start from Deuteronomy, where all Levites have equal priestly rights, this argument and ordinance are plain enough but it is utterly impossible to understand them if the Priestly Code is taken as already existing.

Ezekiel views the priesthood as originally the right of all Levites, while by the Priestly Code a Levite who claims this right is guilty of baseless and wicked presumption, such as once cost the lives of all the company of Korah.

Ezekiel's ideas and aims are entirely in the same direction as the Priestly Code, and yet he plainly does not know the Code itself. This can only mean that in his day it did not exist, and that his ordinances formed one of the steps that prepared the way for it.

In answer to all this it must be understood as a paramount fact that Deuteronomy is a body of laws incomplete in itself. Deuteronomy really follows, is attached to and co-ordinated with the legislation of the preceding books of the Pentateuch. The mutual relations between priests and Levites and their special functions being already specified in the Levitical Law it was entirely unnecessary to repeat the same things in Deuteronomy. All that specially relates to the ministers of religion and the ceremonies of worship finds its place in the Levitical Law rather than in Deuteronomy. Thus in (Deut. XXIV, 8, 9) there is direct allusion to the Law of Leprosy previously given in (Lev. XIII, XIV,) (Deut. X. 8, 9; and XVIII, 1, 2) point out duties already assigned and support allowed to the tribe of Levi, with reference to (Num. XVIII. 20), which establishes the relative status of priests and Levites.

The rescinding of the restriction demanding that every animal slain for food should be presented at the Sanctuary mentioned in (Deut. XII, 15), plainly alludes to the law (Lev. XVII, 3) which could only have been enacted in the Wilderness as a preservative against idolatry and was altogether impracticable in Canaan. This law was then formally abrogated before the entrance of the Israelites into the promised land.

Deut. XXXIII, 8–11, plainly and unequivocally alludes to the preceding history and laws. Deuteronomy thus by its own express account alludes only briefly and summarily to the existence and binding authority of a more detailed antecedent legislation.

It is claimed further that Deuteronomy does not distinguish between priest and

Levite. That is the baldest assertion. The only seeming foundation for it is the words of (Deut. XVIII, 1): "The priests and Levites, and all that are of the same tribe, shall have no part, nor inheritance with the rest of Israel, because they shall eat the sacrifices of the Lord, and his oblations."

The true significance of these words is to affirm that both the priests and the whole tribe to which they belong are without inheritance. Deut. XVIII, 3–5 says: "This shall be the priest's due from the people, and from them that offer victims: whether they sacrifice an ox, or a sheep, they shall give the priest the shoulder and the breast: . . . . For the Lord thy God hath chosen him of all thy tribes, to stand, and to minister to the name of the Lord, him and his sons forever."

And (Deut. XVIII, 6–8): "If a Levite go out of any of the cities throughout all Israel, in which he dwelleth, and have a longing mind to come to the place which the Lord shall choose, ... He shall receive the same portion of food that the rest do: besides that which is due to him in his own city, by succession from his fathers." In this passage a clear and fixed distinction is certainly made between a priest and Levite. Indeed in the whole book of Deuteronomy wherever reference is made to priests the same functions are ascribed to them as to priests in the Levitical Law.

On the other hand where Levites are spoken of they are regarded as objects of charitable beneficence, as a dependent and needy class, as in (Deut. XIV, 29): "And the Levite that hath no other part nor possession with thee, and the stranger, and the fatherless, and the widow, that are within thy gates, shall come and shall eat and be filled: That the Lord thy God may bless thee in all the works of thy hands that thou shalt do."

In (Deut. XXVII, 9, 12, 14) distinction is clearly made between Levitical priests and Levites. Deuteronomy all along makes a distinction between priests of the tribe of Levi who perform priestly duties and Levites who do not.

Deut. X, 6, fixes the priesthood in Aaron and his sons. The Levitical Law similarly establishes the priesthood in the family of Aaron.

This passage of Deut. XVIII, 6, 7): "If a Levite go out of any one of the cities throughout all Israel, in which he dwelleth, and have a longing mind to come to the place which the Lord shall choose, he shall minister in the name of the Lord his God, as all his brethern the Levites DO, that shall stand at that time before the

Lord." The plain meaning of these words is that any Levite whatever can officiate in the sanctuary and perform acts proper to his grade; if a priest, those of a priest; if a Levite, those of a Levite.

In regard to the priestly offerings there is no contradiction between Deuteronomy and the Levitical Law. The former simply alludes briefly to what has been already laid down in a formal and detailed manner by the latter.

The trouble with Wellhausen is that he is unwilling to take the author's plain meaning. He tries to force upon the passages meanings entirely foreign to the language. Wellhausen is the Ignatius Donnelly of the Pentateuch. With a great show of learning, shrewdness and verisimilitude he feigns to find an adroitly hidden cipher in the Pentateuch which the sacred penman never dreamed of putting there.

Chapter VI.

THE CREATION.

Genesis Kosmou (Generation of the World) or briefly Genesis, is the name of the first book of the Pentateuch and is so-called from its account of the origin of the world.

For convenience sake it has been separated into fifty chapters, but its subject matter seems naturally to divide itself into two parts; the first of which reaches from the first to the twelfth chapter and the second from the twelfth to the fiftieth chapter.

The first part of Genesis contains the history of the creation, an account of the terrestrial paradise, the fall of man, the deluge, the repeopling of the earth, the Tower of Babel, the confusion of tongues, the dispersion of mankind, the genealogies of the patriarchs from Adam to Abraham; and of the religion, arts, settlements, corruption and destruction of the antediluvian world.

The second part gives a history of the patriarchs from Abraham to Joseph and embraces an account of the rise and progress of the Hebrew nation.

In the Hebrew scriptures this first book of Moses is called Bereshith, from the first word in the text: "In the Beginning" (bereshith). Its narrative goes back to the very twilight of antiquity and embraces a period variously estimated at from 2300 to 3619 years.

Independently of the rest of the Pentateuch, to which it stands as an introduction, Genesis forms of itself a complete whole and although portions of it seem discordant, it being of the character of a diary, nevertheless it does not want essential unity.

Much of Genesis must have been the work of direct revelation. Some portions, it would seem, Moses wrote under the influence of inspiration, from patriarchal tradition, and probably some parts, too, from more ancient documents already existing.

The cosmogony of Moses is certainly infinitely more sublime and morally superior to all other accounts of the creation.

The discovery of similar traditions regarding the creation in the religious records of other primeval nations is a powerfully corroborating proof of the historical truth of the Mosaic account. And particularly as far as language is concerned the most recent and most intelligent investigations affirm the Mosaic division of mankind into three principal races, corresponding to the descendants of Noah's sons, Shem, Ham and Japhet, to be substantially correct.

The first chapter of Genesis contains Moses' sublime and noble history of creation: "In the beginning God created the Heaven and the Earth. And the earth was void and empty, and darkness was upon the face of the deep; and the spirit of God moved over the waters. And God said: Be light made. And light was made.

And God saw the light that it was good: and He divided the light from the darkness. And He called the light Day, and the darkness Night: and there was evening and morning one day.

And God said: Let there be a firmament made amidst the waters: and let it divide the waters from the waters.

And God made a firmament, and divided the waters that were under the firmament, from those that were above the firmament. And it was so.

And God called the firmament, Heaven: and the evening and morning were the second day.

God also said: Let the waters that are under the Heaven, be gathered together into one place: and let the dry land appear. And it was so done. And God called the dry land, Earth: and the gathering together of the waters he called Seas. And God saw that it was good.

And He said: Let the earth bring forth

the green herb, and such as may seed, and the fruit tree yielding fruit after its kind, which may have seed in itself upon the earth. And it was so done.

And the earth brought forth the green herb, and such as yieldeth seed according to its kind and the tree that beareth fruit, having seed each one according to its kind. And God saw that it was good.

And the evening and the morning were the third day.

And God said: Let there be lights made in the firmament of heaven, to divide the day and the night, and let them be for signs, and for seasons and for days and years:

To shine in the firmament of heaven, and to give light upon the earth. And it was so done.

And God made two great lights: A greater light to rule the day: and a lesser light to rule the night: and stars.

And he set them in the firmament of heaven, to shine upon the earth.

And to rule the day and the night, and to divide the light and the darkness. And God saw that it was good.

And the evening and morning were the fourth day.

God also said: Let the waters bring forth the creeping creature having life, and the fowl that may fly over the earth under the firmament of heaven.

And God created the great whales, and every living and moving creature, which the waters brought forth, according to their kinds, and every winged fowl according to its kind. And God saw that it was good.

And he blessed them saying: Increase and multiply, and fill the waters of the sea: and let the birds be multiplied upon the earth.

And the evening and morning were the fifth day.

And God said: Let the earth bring forth the living creature in its kind, cattle, and creeping things, and beasts of the earth according to their kinds: and it was done.

And God made the beasts of the earth according to their kinds, and cattle, and everything that creepeth on the earth after its kind. And God saw that it was good.

And he said: Let us make man to our image and likeness; and let him have dominion over the fishes of the sea, and the fowls of the air, and the beasts, and the whole earth, and every creeping creature that moveth upon the earth.

And God created man to his own image: to the image of God he created him, male and female he created them.

And God blessed them, saying: Increase and multiply, and fill the earth, and subdue it, and rule over the fishes of the sea, and the fowls of the air, and all living creatures that move upon the earth.

And God said: Behold, I have given you every herb bearing seed upon the earth, and all trees that have in themselves seed of their own kind, to be your meat.

And to all beasts of the earth, and to every fowl of the air, and to all that move upon the earth, and wherein there is life, that they may have to feed upon. And it was done.

And God saw all the things that he had made; and they were very good. And the evening and morning were the sixth day."

There are various opinions concerning the nature of the six days mentioned in Genesis in which the creation was accomplished.

Some regard them as ordinary mean solar days of twenty-four hours each, and take the words of Moses in their strict literal sense, claiming that God in creating the earth could by his omnipotent power impress upon it instantly all the marks and features of age.

Others while looking upon the days of Genesis as mere solar days, consider that the creation of matter and its evolution from its primeval chaotic state into the universe as we now see it, were accomplished in that indefinite period designated in Genesis as: "In the beginning."

Again other theorists believe in a series of successive revolutions, whereby the world was destroyed and renewed. Many ancient cosmogonies seem to agree with this view.

Others still regard the days of creation as mighty epochs during the progress of which the earth and its neighbors in space grew slowly by evolution into their present shape.

The church has not spoken upon the matter. She has formulated no definition of the length of the Mosaic days. So that a Catholic can hold the opinion that the days of Genesis were not ordinary ones, but great epochs, without in the slightest degree compromising his faith.

The hypothesis of epochs for the days of creation would bring Genesis, Astronomy, Geology and Biology into essential harmony.

A great number of Biblical commentations claim that the Hebrew word *iom* from which dies, day, is translated is frequently used in Scripture for an epoch.

The supporters of this opinion say that it is quite evident "that the duration of the three first days must be to us an indefinite period, as we can neither refer them to, nor compare them with, any known standard, as the planets destined to point out the times and the seasons, the days and the nights, were not then in existence, not being formed until the fourth day. And as Moses makes no distinction between the three first and the three last days, the inference will follow, that the word *day*, preceded by the terms *first* and *second*, was made use of by him to determine the order of the successive creations composing the universe, and not for pointing out any definite space of time."

St. Augustine (Gen. B. IV, Note 44) says: "That we should not hastily pronounce on the nature of the six days of creation, nor assert that they were similar to our ordinary days." And in his City of God (De Civ. Dei, lib. I ch. VI.): "That it is difficult and even impossible for us to imagine, and even more so to say, what might be the nature of those days."

We may safely then regard the days of Genesis as epochs of indefinite length during the lapse of which took place those successive creations mentioned by Moses.

Evolution is everywhere apparent in nature. The man is evolved from the child, the mighty oak from the sapling, the plant from the seed. God could have prepared the world by evolution for the separate creations of more perfect species. It is not more difficult for God to have created the universe by evolution than to sustain it by motion.

Let us now consider the order of creation as recorded in Genesis.

In the beginning God created Heaven and earth or all matter. This matter made its first appearance in a state designated by Moses as "void and empty" or in a completely chaotic condition.

Then began under the infinite intelligence and power of God the successive mouldings of this immense mass of sluggish formless matter into symmetrical worlds.

On the first day and anterior to Sun or Moon, God created Light or formed the luminous substance known as ether and which extends out to the boundless limits of space and permeates the interstices of all bodies.

When the earth began slowly to draw away from the immense mass of chaotic vapor and to shape itself under the resultant force of motion and gravitation it was nothing more in appearance than a great cloud or globular fog-bank.

The dense inner portion of this vaporous mass began to form the earth's heavy nucleus and draw away from the lighter cloud mass set floating in the air and thus the waters beneath were divided from the waters above by a permanent expanse called by Moses the Firmament. On the second day God formed this Firmament or Heaven.

On the third day the oceans and continents were formed, the dry land was parted from the mass of waters on the earth's surface, and the simplest forms of life appeared called by Moses: "The green herb, and such as may seed."

It is well to notice just here that the lowest kinds of vegetable and animal life, the protophyte and protozoon, do not require the chemical rays of the Sun for their growth and substance. This first form of cell life needs only a warm soil and a moist atmosphere strongly saturated with carbonic acid gas for its support and development.

On the fourth day appeared the Sun, Moon and Stars. The great central orb after throwing off its different rings of vapor became more and more condensed under the action of its own gravity and began gradually to assume its present shape and appear as a glowing sun.

The earth's offspring, the Moon, settled down to its offices of a most beneficent satellite.

Our planet's atmosphere, also, became sufficiently clear to render visible the twinkling of the stars.

The firmament here referred to by Moses is the limitless expanse stretching out into interstellar space and which differs only from the firmament of the second day, in being its prolongation.

In the cosmogony of Moses the heavenly bodies are important relatively to their influence upon our planet and hence the Sun and Moon are called two great lights although there are suns in space much brighter and greater than our own.

On the fifth day God made the fishes and the birds. When the seasons were established and the sun's chemical rays beamed upon the earth and rendered it suitable as the habitation of a higher type of life than the protophyte and the protozoon God called forth the fishes and the birds. The fifth day was the proper age of the lower animals, of the creeping creatures, that swarm in the waters, and the fowl that fly over the earth.

Nowhere, however, in God's creation is the higher species of animals evolved from the lower. In God's work there is no descent of species. There was a progress of species, but this progress does not signify that the earliest species were necessarily the lowest to be always followed by a higher type. In the more imperfect conditions of life, the more common type is the precursor, but not ancestor, of its betters in the better conditions which successively followed each other.

On the sixth day God created the higher animal life, the mammals, or as Moses states it, the beasts of the earth according to their kinds are brought forth, and cattle, and everything that prowleth on the earth. And lastly on this sixth day God made man to his own image and likeness.

Another view of the days of Genesis would be to regard them in a figurative or symbolical sense and the Mosaic narrative as more of a theological than a historical account of creation. Philo, Origen, Procopius and many ancient commentators took this view of the matter long before our modern geological discoveries, and so were not driven to it by the progress of the physical sciences.

As the figure of the eye is symbolical of sight so the six days are symbolical of the successively accomplished works of the creator.

According to the symbolic sense the days of Moses "are not any succession of time, but a succession of order and reason, for the express purpose of proportioning himself to the understanding of the people, and to give them a more distinct notion of the creation of beings by distributing them in this way into divisions, and according to a certain classification."

These commentators, then, understand the six days to be neither literal days not any measure whatever of time, but symbolical expressions under which the works of creation are classified; a succession in the order of conception, but not in the order of events; not in the order of execution, but in the plan; not as things happen before the eyes of men, but in the mind of God.

In this view it would not matter which creatures were created first and which last, as neither measure of time, nor order of succession is attributed to the text. In this way there could not be possibly any clash between the Mosaic cosmogony and scientific discoveries.

Under this interpretation the object of Moses was purely a religious one. It was simply to teach, in accordance with the old patriarchal traditions that all things, water, air, earth, light, sun, moon, stars, plants, fishes, reptiles, mammals and man himself had been created according to their natures and that the substance of the world was not eternal but called into existence by the will of God.

This symbolic interpretation is indeed a very ancient one, but in our times it is neither a very common nor a popular one.

Chapter VII.

MOSES AND LAPLACE.

There is certainly nothing in Biblical literature that has given rise to such violent controversies as the Mosaic cosmogony. It is claimed by many distinguished votaries of astronomy, geology, chronology and biology, that these sciences have discovered undeniable physical facts irreconcilable with explicit statements in the opening chapters of Genesis.

It is claimed that modern science and Genesis are at variance concerning the age of the world and the creation and formation of the universe. Is, then, the cosmogony of Laplace contradictory to that of Moses?

Among a number of modern hypotheses purporting to account for the present harmonious mechanism of the world the most beautiful and famous is the Nebular Hypothesis of Laplace. This nebular hypothesis does not concern itself with the origin of matter, supposing it already in existence, and treats only of its transformations.

Laplace begins by supposing the sun not only as already having some existence, but as having acquired some development, as having in fact a more or less dense nucleus, surrounded by a rare, elastic atmosphere of vast extent.

He considers this nucleus as either solid or so dense, compared with the atmosphere, as to be relatively solid, and to contain by far the greatest amount of the body's mass.

He assumes, for the sake of convenience, the form of this nucleus to be already reduced to that of a spheroid, differing but slightly from a sphere; but the shape of the atmosphere's bounding surface he leaves to be determined solely by the resultant of the centrifugal and gravitating forces, springing from any given mass and velocity of rotation that the body can have.

The nucleus and atmosphere are rotating on an axis. Laplace calls the distance of that portion of the atmosphere from the axis where the centrifugal force just balances gravity, the centrifugal limit.

Laplace then demonstates mathematically that at the centrifugal limit of the atmosphere of a rotating body, over the equator, the equatorial radius is to the polar precisely as three to two.

When, then, the axial motion of the sun became so great that the centrifugal force caused its atmosphere's equatorial axis to be to its polar as three to two, the outer portion of the atmosphere would leave the sun.

Laplace supposed that owing to excessive heat the atmosphere of the sun extended beyond the orbits of all the planets, and that it has successfully contracted up to its present limits.

He conjectures that the planets were formed at the successive centrifugal limits of the solar atmosphere by the condensation of the zones of vapor which, in cooling, it had been obliged to abandon in the plane of its equator. But this hypothesis of Laplace is so beautiful and so important that it is best to give the great mathematician's own words: "The atmosphere of the sun," he says, "could not extend outward indefinitely. Its limit is the point where the centrifugal force, due to its axial motion, balances gravity.

"Now, in proportion as its cooling causes the atmosphere to contract and to be condensed towards the sun's surface, the motion of rotation must increase. For, by virtue of the principle of areas, the sum of the areas described by the radius-vector of each molecule of the sun and of its atmosphere, when projected on the plane of his equator, being always the same, the rotation ought to be more rapid when these molecules are brought nearer the sun's centre. The centrifugal force, due to this increased motion, thus becoming greater, the point at which gravity is equal to it, approaches nearer the sun's centre.

" By supposing, therefore, what it is very natural to admit, that the sun's atmosphere at any epoch had extended up to this limit, it would be necessary, on further cooling, for the atmosphere to abandon the molecules situated at this limit and at the successive limits produced by the increase of the sun's rotation.

" These molecules, thus abandoned, have continued to circulate around the sun in the same direction as before, since their centrifugal force was just balanced by their gravity towards the sun.

" But this equality of centrifugal force and gravity not taking place with regard to the atmospheric molecules placed on the parallels to the solar equator, these latter molecules, by their gravity, will follow the atmosphere in proportion as it is condensed, and will not cease to belong to it until by their motion they have reached the equator.

" Let us consider now the zones of vapor successively abandoned. These zones ought, most probably, to form by their condensation and the mutual attraction of their molecules, various concentric rings of vapor revolving around the sun. The mutual friction of the molecules of each ring ought to accelerate those moving more slowly, and retard the swifter, until they should all have acquired the same angular motion about the sun.

"Hence, the real velocity of the molecules farthest from the sun will be the greatest.

"The following cause ought to contribute also to this difference of velocity. The molecules of the ring most distant from the sun, and which, by the effect of cooling and condensing, are brought nearer, so as to form the outer portion of the ring, have always described areas proportioned to the time; since the central force by which they are animated has been constantly directed towards the sun's center.

"Now, this constancy of areas requires an increase of velocity in proportion as they approach the centre of motion. It is evident that the same cause ought to diminish the velocity of those molecules which, by the cooling and contracting process, are carried outwards to form the inner part of the ring.

"If all the molecules of one of these vaporous rings had continued to condense without separating, they would have formed at last a liquid or a solid ring.

"But the regularity which such a formation requires in all parts of the ring, and in their rate of cooling, ought to render this phenomenon extremely rare.

"Hence the Solar System offers but a single example of it; namely, that of the rings of Saturn. Almost always each vaporous ring ought to be broken into several masses, which, moving with nearly the same velocity, have continued to revolve around the sun at the same distance from him.

"These masses ought each one to take on a spheroidal form, with a motion of rotation in the same direction as their motion of revolution around the sun; since their molecules nearest to him had less velocity than those farthest from him.

"They must, therefore, have formed so many planets in a vaporous condition. But if one of them had been large and powerful enough to successively reunite by its attraction all the others around its own centre, the vaporous ring will have been thus transformed into a single spheroidal vaporous mass revolving around the sun nearly in the plane of his equator, with a nearly circular orbit, and with its motion of rotation generally in the same direction with that of its revolution around the sun.

"This last case has been the most common; but the solar system offers to us an example of the first case in the four small planets revolving between Mars and Jupiter, unless we suppose, with Olbers, that they formed at first a single planet which some strong explosion has divided into several parts, animated by different velocities.

"If, now, we follow the changes which further cooling ought to produce in the planets consisting of vapor, the formation of which we have just considered, we shall see a nucleus begin at the centre of each of them, and see it grow continually by the condensation of the atmosphere which surrounds it.

"In this state the planet perfectly resembles the sun in the nebulous condition which we have been considering. Its cooling ought, therefore, to produce, at the different centrifugal limits of its atmosphere, phenomena similar to those which we have described; that is to say, rings and satellites revolving around its centre in the direction of its motion of rotation, and the satellites rotating also in the same direction on their axes.

"The regular distribution of the mass of Saturn's rings around his centre, and in the plane of his equator, results naturally from this hypothesis, and without it becomes inexplicable. These rings appear to me to be the ever-existing proof of the former extension of Saturn's atmosphere, and of its successive contractions.

"Thus, the singular phenomena of the small eccentricities of the orbits of the several planets, and those of their satellites, or their almost circular orbits, the small inclinations of these orbits to the sun's equator, and the identity of the motions of rotation and revolution of all these bodies with that of the sun's rotation, flow from the hypothesis which we propose, and give to it a great probability, which may be still further increased, by the following considerations.

"All the bodies which revolve around a planet, having been formed, according to this hypothesis, by the zones which its atmosphere has successively abandoned, and the planet's motion of rotation having become more and more rapid, the duration of this rotation ought to be less than those of the revolution of these different bodies. This must be true, likewise, for the sun in comparison with the planets. All this is confirmed by observation.

"The duration of revolution of Saturn's nearest ring is, according to Herschel's observations, 0.438 d., and that of Saturn's rotation is 0.427 d. The difference, 0.011 d., is small, as it ought to be; because the part of Saturn's atmosphere which the loss of heat has condensed upon the planet's surface since the formation of this ring being small, and coming from a small height, it ought to have produced but a small increase of the planet's rotation.

If the Solar System had been formed with perfect regularity, the orbits of the bodies which compose it would have been perfect circles, whose planes, as well as those of the different equators and rings, would have coincided exactly with the sun's equator. But we can conceive that the innumerable varieties which ought to have prevailed in the temperature and density of the several parts of these great masses have produced the eccentricities of their orbits and the deviations of their motions from the plane of the sun's equator.

"In our hypothesis the comets are strangers to the planetary system. Considering them, as we have done, as small nebulæ wandering from one solar system to another, and formed by the condensation of nebulous matter so profusely scattered throughout the universe, it is evident that when they arrive at that part of space where the sun's attraction predominates, he compels them to describe elliptical or hyperbolic orbits. But their velocities being equally possible in all directions, they ought to move indifferently in all directions, and under all inclinations to the ecliptic, which is conformable to observation.

Thus the condensation of nebulous matter, by which we have explained the motions of rotation and revolution of the planets and satellites in the same direction and in planes of small inclination to each other, explains equally why the comets depart from this general law." (The Author's Astronomy, page 234).

Reasoning backward from the point where he assumed, for convenience, the sun to be a dense nucleus with a hot extensive atmosphere, Laplace supposes the radiant orb, in a more primitive state, to resemble those nebulæ shown by the telescope to be composed of a brilliant nucleus surrounded by a nebulosity which, by condensing towards the surface of the nucleus, transforms it into a star.

Judging from analogy, he supposed the stars all formed in this way by condensation from nebulous matter. Each condition of nebulosity was preceded by other conditions, in which the nebulous substance was more diffused, and the nucleus less luminous and less condensed. In this way he reaches a condition of nebulosity barely existing.

Because our planets and satellites are the offspring of the same atmosphere in whose primitive motion all partook, Laplace points out as proofs of the truth of his hypothesis: that the movements of the planets are all in the same direction, and nearly in the same plane;

That the motions of the satellites are in the same direction as those of the planets;

That the rotations of these different bodies, and of the sun, are in the same directions as their orbital motions, and in planes that vary but little from each other;

That the paths of both planets and satellites are nearly circular, or of small eccentricity;

That, contrarily, the orbits of comets are of great eccentricity, and of every inclination to the ecliptic, and that their motions are in all directions.

Let us now place side by side the days of creation and the successive developments of the Nebular Hypothesis. If the days are taken in the sense of ages or epochs the agreement between the two cosmogonies is indeed wonderful.

The First and Second Days of Moses and the Nebular Hypothesis: The earth was a portion of that nebulosity embracing the materials of the sun and all the planets and satellites. Matter was held in this nebulous condition because of its immense stores of latent heat.

This nebulous cloud gradually began to turn itself upon an axis by a natural law of mechanics and to radiate its heat into space and so to gradually cool and condense towards a nucleus or centre.

In this fiery cloud were the vapors of rocks and metals and metalloids and indeed of all the elements known to the earth and planets.

Thus far indeed the condition of things in this scheme of worlds of ours was "void and empty."

The external portion of this vast cloud touching the cold of space, 400° Fahrenheit below zero, began to gradually liquefy and fall upon the lighter and hotter nucleus in showers of molten metal.

These were again reduced to a vaporous state and driven forth towards the surface, not however without the fiery mass being deprived of a portion of its heat, to be again cooled by radiation and again thrown back upon the centre like condensing clouds. This process continued until a thin crust of solidified material was formed on the surface of the glowing mass.

The earth grew cooler and cooler gradually through the continued action of radiation. Water condensing from its vapor began to form upon the solidified crust of the earth. As is the condition now upon the planet Venus, which is covered with a cloud-mantle, in which there is scarcely ever a rift, continuous rains prevailed for a long period upon the earth, maintaining a thick and constant darkness. The time came when these incessant rains began to gradually abate and the clouds were rent asunder and the atmosphere became a permanent matter dividing the water above from the water beneath. This atmosphere is the "expanse" or "firmament" of Moses.

On the Third Day, owing to the awful heat of the interior, the newly formed crust of the earth was greatly and constantly convulsed, causing upheavals and depressions.

In some sections appeared the dry land and in others the waters were gathered together forming oceans and seas.

The great central mass had thus far thrown off Neptune, Uranus, Saturn, Jupiter, Mars and the earth. It had yet to cast off Venus and Mercury and so was still in a nebulous condition and not sufficiently condensed to be regarded as a sun.

This was now the great age of vegetation upon the earth, or the carboniferous period, and corresponded probably to the present condition of things on the planet Venus. The herbaceous trees and rank vegetation of this epoch did not require the sun's rays for their growth.

On the Fourth Day the central molten mass, having thrown off all the planets and satellites, condensed into a sun, and the Moon had assumed its proper position as a satellite, it having been previously thrown off by the earth.

These two great lights and the stars now appeared in the sky, visible to the earth, because the cloud-canopy of the earth had been rent asunder and the firmament was sufficiently clear of clouds to allow a view of the heavenly bodies from the earth.

Moses called the sun and moon two great lights of the firmament, although compared with other bodies in the universe they are really insignificant. But Moses was evidently giving the genesis of the earth and naturally regarded the other bodies as of secondary consideration, and gave them prominence as they stood towards the earth relatively of more or less importance.

After the appearance of the sun, moon and stars, Astronomy steps down and leaves the consideration of the further developments of the Nebular Hypothesis to the science of Geology.

The distinguished astronomer Pritchard (1889), speaking of Genesis, has this to say: "That it could not originally have been intended to give a scientific account of creation in its precise order, or method, or limitation of time, I am convinced when I read of (1) the existence of water before the appearance of the sun; (2) the clothing of the earth with fruit trees and grass, each bearing its fruit, before the creation of the sun; (3) the successive orders or stages of creation occupying each one single day (The Creation Proem of Genesis, page 262)."

Waters could certainly have existed upon the earth's surface anterior to the contraction of the central mass of our system into a sun properly so called.

The nebulous mass of the earth thrown off by the sun was comparatively small and had already radiated into space much of its latent heat and had greatly condensed even before the planet Venus was cast off from the central mass. Small heated gaseous bodies cool and condense much more rapidly than large ones. The immense volume of the sun had to contract ninety-two and one half million miles while the very small volume of the earth had to shrink only through a quarter of a million miles. Whilst the sun was yet partially nebulous the crust of the earth must have been already formed and covered in places by water.

Pritchard's second objection, the clothing of the earth's surface with vegetation before the appearance of the sun, is sufficiently answered by saying that naturalists now almost unanimously admit that vegetation could exist and grow luxuriantly, in a warm soil and in an atmosphere strongly saturated with watery vapor and carbonic acid gas, independently of the rays of the sun.

His third objection is answered by assuming the days to be epochs, or if literal days, by assuming the expression of Genesis, "In the Beginning," as an indefinite period during the lapse of which all developments could have occurred.

The different sciences are continually changing. They are gradually and constantly improving. With each new light shed upon them a favorite hypothesis considered as all but established has to be abandoned.

Through all the world's vicissitudes the Pentateuch has held its sacred ground and still holds the reverence of the civilized world. Discoveries, particularly in the new sciences, seemed at first to contradict some statements of Moses, but later on, when the sciences became better developed, the seeming contradictions disappeared.

A remarkable instance of this was presented by the science of Optics. When modern Optics was in its infancy, there was a great out-cry because Genesis announced the creation of Light anterior to the sun's existence. But when Young and Fresnel discovered by genius and hard work the true laws of Optics, it was seen that this science and the Pentateuch were in perfect accord regarding the nature of Light.

New opinions in science are often received by inexperienced amateurs with great favor and enthusiastically embraced without proper care.

When these seem to be at great variance with Biblical records, it is wise, as past experiences show, to be slow in accepting them. Time and experiment may change them altogether.

Astronomy is certainly one of the oldest and it has always been called the most perfect of the sciences. The Nebular is one of its pet hypotheses. In the time of the Elder Herschel it was looked upon as an established Theory. But when the mighty telescope of Parsonstown let in its flood of light on astronomy, the island universes of space commenced to be resolved into starry points, and the scheme of Laplace began to weaken. The great Hypothesis is now regarded as all but a failure.

Laplace likened the Solar System in its primitive state to the distant nebulæ, which he looked upon as forming star systems, and external to, and quite distinct from, the sidereal universe.

But these nebulæ are not external galaxies, nor distinct from the sidereal system, but are indeed part and parcel of it.

From the examination of the great irregular nebula surrounding Eta Argus, the great Orion nebula, the nebulæ of the Nubeculæ, and similar nebulæ, it cannot be doubted that a real and close association exists between the stars and nebulæ, and that they really constitute but a single system.

According to Laplace, the primary must rotate on its axis in less time than its satellite revolves about it.

The inner satellite of Mars, on the contrary, revolves about him three times while he is rotating once. Here is an observed fact, opposing the Hypothesis.

The sun has by tidal action somewhat retarded the axial velocity of Mars, but certainly not to this extraordinary extent.

It is admitted that the earth's axial motion has been but little affected by solar tidal action. Solar tides on Mars could not, then, have produced such wondrous effects.

If the mass of Mars be less than the earth's, his diameter is also much less, and, other things being equal, tidal action is proportioned to the diameter of the body acted upon. Mars, too, is one and a half times more distant than the earth from the sun.

One of the main pillars of Laplace's hypothesis is the uniformity of the motions, both axial and revolutionary, of the planets and satellites in the same direction from west to east. Here again is an observed fact against the hypothesis. The satellites of Uranus, and that of Neptune, are known to have a retrograde movement.

There is a great dynamical principle known as the conservation of the "moment of momentum." This conservation of the moment of momentum differs entirely from what is known as the conservation of energy.

The energy of the solar system can be transformed into heat, and a portion of it constantly dissipated and lost in space, but no action of the system itself can ever alienate a single iota of the moment of momentum.

The relative distribution of the moment of momentum may be altered, but the total amount, barring external influence, can never be changed.

If we multiply Jupiter's mass by his angular orbital motion in one second, and the product by the square of his distance from the sun, we obtain Jupiter's orbital moment of momentum.

If we multiply Jupiter's mass by his angular rotatory motion in one second, and the product by the square of a line depending on his constitution, we have his rotational moment of momentum.

Similarly the moments of momentum of the other planets are deduced.

If we multiply the sun's mass by his angular rotatory motion in one second, and the product by the square of a line depending on his constitution, we obtain his rotational moment of momentum.

Professor Ball gives the following distribution of the moment of momentum in the Solar System, the total being taken as 100.

Orbital moment of momentum of Jupiter	60
Orbital moment of momentum of Saturn	24
Orbital moment of momentum of Uranus	6
Orbital moment of momentum of Neptune	8
Rotational moment of momentum of the Sun	2
Total	100

The other bodies are not considered, their moment of momentum being comparatively infinitesimal.

Professor Ball says: "It might be hastily thought that, just as the moon was born of the earth, so the planets were born of the sun, and have gradually receded by tides into their present condition. We have the means of inquiry into this question by the figures just given, and we shall show that it seems utterly impossible that Jupiter, or any of the other planets, can ever have been very much closer to the sun than they are at present."

Above all it seems utterly impossible that

Jupiter could have received his orbital moment of momentum from the sun.

Laplace's hypothesis places the centrifugal limits of the abandoned portions of the revolving glowing atmosphere of the sun widely apart. After abandoning the first vaporous ring, the atmosphere contracts to nearly one-half its primitive bulk before throwing off another. The abandonment of each ring was followed by an immense atmospheric shrinkage.

This would demand such great cohesion in a glowing mass of vapor as it is difficult to concede it possessed. It would seem to be more in accord with the character of a gaseous body that, when the centrifugal limit was reached the first time, the outer mass, under the influence of centrifugal force, would partially separate from the portions next to it; then these would separate next, and so on. In this way, instead of a series of rings, there would be a constant dropping off of matter from the outer portions, producing an almost infinite number of concentric rings, all joined together. Thus, there would result a meteoric instead of a planetary system. This is the objection of Professor Kirkwood.

Professor Newcomb considers that the rings were all thrown off together, and that the inner and smaller bodies are, if anything, the older.

Faye thinks that the outer planets were formed last.

Thus, it appears that Laplace's hypothesis is far from being established, if indeed, it has not altogether failed. (The Author's Astronomy, Pages 234–244.)

Scientists should above all things avoid dogmatism, and this particularly in regard to those sciences which are in their infancy. The Pentateuch has held its own through all the ages, has won the reverence of all civilized peoples and bears the seal of the approvement of a great nation. Many sciences, when still in the cradle, seemed to contradict it, which afterwards, when better established, were found to be in perfect accord with it. So that when Science and Genesis seem to clash, let us not pass too rapid a judgment against an old friend, but await patiently until the principles of science are properly classified and firmly established.

Chapter VIII.

PROVIDENCE IN THE WORLD.

There is no essential contradiction between science and the Bible. Indeed they sustain each other. One of the chief aims of the Bible is to teach that the world is under the guidance of a benign and divine Providence. The Bible teaches that God made the world and governs it. Science teaches the very same thing.

A very cursory study of the material world and its laws suggests to the observer the unwearied presence of a wise and presiding Providence. The world is governed by general laws which are fixed and constant. There is nothing left to chance in the government of the physical universe.

The earth's rotation on its axis regulates the length of the day, its revolution around the sun, that of the year, and the oscillation of its polar axis, the duration of the seasons. Thus the motions of the earth occasion the succession of days, seasons and years; and these motions are regulated by the attraction of the solar mass, which is absolutely invariable in its action.

Atmospheric forces and the weather itself, apparently so capricious, are governed by fixed and regular laws; the heat of the sun being the chief element in determining the character of the weather.

Invariable laws likewise govern the vital movements of animals and plants. In the nature and operation of these laws we will find upon examination the reign of benevolence and foresight, and so will be moved to admire the goodness and wisdom of the Almighty Law-giver.

"When we speak of material nature as being governed by LAWS, it is sufficiently evident that we use the term in a manner somewhat metaphorical. The laws to which man's attention is primarily directed, are MORAL laws: rules laid down for his actions; rules for the conscious actions of a person; rules which, as a matter of possibility, he may obey, or may transgress; the latter event being combined, not with an impossibility, but with a penalty. But the Laws of NATURE are something different from this; they are rules for that which THINGS are to do and suffer; and this by no consciousness or will of theirs. They are rules describing the mode in which things do act; they are invariably obeyed; their transgression is not punished, it is excluded. The language of a moral law is, man SHALL not kill; the language of a Law of Nature is, a stone WILL fall to the earth." (Whewell).

It will be seen by observation that the

laws of nature are remarkably adapted to the office which is assigned them and afford proof of selection, design and goodness in the power by which they were established.

The number and variety of nature's laws are great indeed, and it would be futile to attempt their examination in full in a single chapter. In their operations they are combined and intermixed in incalculable and endless complexity, influencing and modifying each other's effects in every direction. If we try to comprehend at once the whole of the complex system, we find ourselves utterly baffled by its extent and multiplicity. Still so far as we consider the bearing of one part upon another, we receive the impression of adaptation, purpose and provision.

Let us then consider some cases in which the different parts of the universe exhibit this mutual adaptation and thus see the evidence of Providence and Wisdom which the world of nature affords. The idea of a preserving and contriving mind in framing the world and its laws will spring up before us when we see the correspondencies which exist everywhere in nature between the qualities of brute matter and the constitution of living beings, between the tendency to derangement and the conservative influences by which such a tendency is counteracted.

We will find a general agreement between the nature of the laws which govern the organic and inorganic world. Plants and animals have, in their construction, certain periodical functions which have a reference to alternations of heat and cold; the length of the period which belongs to these functions by their construction, appears to be that of the period which belongs to the actual alternations of heat and cold, namely, a year.

Plants and animals have again in their construction certain other periodical functions, which have a reference to alternations of light and darkness; the length of the period of such functions appears to coincide with the natural day.

The members of the organic world are also adapted by the various peculiarities of their construction to the effects of gravity on the air and moisture and other elements which it controls.

Creatures are created on a plan and scale which is exactly the single one suited to their place on the earth. The Creator in producing one part of his work was always mindful of the other. He took an account of the weight of the earth, the density of the air and the measure of the ocean in creating living beings. He did not cast his living creatures into the world to prosper or perish as they might find it suited to them or not; but fitted together, with the nicest skill, the world and the constitution which he gave to its inhabitants. Everything has been arranged for their well-being.

There is a cycle or periodicity of internal functions in the vegetable kingdom that corresponds exactly to the length of a year. The length of the year is so determined as to be adapted to the constitution of most vegetables, or the constitution of vegetables is so adjusted as to be suited to the length the year has, and unsuited to a duration longer or shorter by any considerable portion. The vegetable clock-work is set for a year.

The length of the year is determined by the time required by the earth to perform a revolution around the sun. If we suppose the earth to be placed nearer to the sun, such as in the case of the planet Venus, or farther away, such as that in the planet Mars, the length of our year would be greatly shortened or lengthened.

A change of this kind would throw our botanical world into absolute disorder. The whole vegetable world, according to the opinion of the best naturalists, would suffer rapid extinction.

The function of the vegetable kingdom has a periodicity depending on the length of the year. The appearance of fruit, of leaves and flowers, the flowing of sap and other vital functions depend entirely on the duration of the year. If it were radically changed all vegetables would die and disappear. Artificial agencies might suffice for a short time. But ultimately the vegetable world would decay. This correspondence between the cycle of the year and the periodicity of vital functions in plants is not the offspring of chance. There is here design, intention and wise provision.

The periodicity of certain functions of plants depends on the length of the day or the time of rotation of the earth on its axis. The opening and shutting of their flowers by certain plants and other physiological functions are regulated by the length of the day and the alternation of light and darkness. There is here a physiological period adapted to the astronomical period of twenty-four hours.

Jupiter's day is about ten hours and the Moon's day more than twenty-nine of our days. If the period of the earth's rotation was greatly altered it would be very detrimental to, if not destructive of, the vegetable kingdom. There is an adaptation between the structure of plants and the periodical order of light and darkness resulting from the earth's rotation, which it would be unphilosophical to attribute to chance. It is no other than a wise and intentional adjustment.

The great physiologists say that animals and man himself have a period in their functions regulated by the duration of the day. The inclination to food and sleep particularly depends on the day's length. The day's length could not be shortened or lengthened very considerably without grave injury to many vital functions of animal life.

Again the intensity of the force of gravity was taken into account in the establishing of the laws governing the constant motion of the fluid parts in the life of vegetables and animals. The force of gravity depends upon the mass of the earth. The earth's mass might have been greater than Jupiter's or less than Mercury's. It could easily have been twelve or twenty times greater than it is. That would mean that the sap could no longer flow upwards in vegetables and that animal motions upon the earth would be impossible.

The sap in vegetables, plants and trees flows upwards with great force. A vine in the bleeding season can push up its sap in a glass tube to the height of twenty-one feet above the stump of an amputated branch. The force which carries up this sap is a mechanical one and is a mixture of capillary attraction and endosmose.

Now then, we find on the earth these two forces of gravity and capillary attraction perfectly so adjusted to one another as is best suited to the best welfare of vegetable life.

There are many other functions of vegetables too numerous to mention which are regulated by and dependent upon the amount of the force of gravity of the earth.

In the muscular powers of animals is found another instance of the adjustment of organic structure to the force of gravity. If gravity on the earth's surface was very much greater than it is, animals could scarcely crawl on the earth's surface and they would be overpowered by the increased weight of the atmosphere.

If the force was very much less, there would be no steadiness on the earth's surface, bodies would slide along with the slightest push and respiration would be impossible owing to the thinness of the air.

The structure of organized beings had also to be adapted to the magnitude of the ocean. Laplace placed the average depth of the ocean at five miles. Recent computations have placed it at three miles. An addition to the ocean of one half of the present waters would drown the globe and make the surface of the earth similar to that of the planet Mars.

If the amount of the waters were decreased materially, the average amount of moisture in the air would be so diminished that the nature of our climates would be radically changed.

The quantity of the atmosphere had to be regarded and be adjusted to organized beings, plants and animals. If the quantity of the air were considerably greater than now, its pressure would be detrimental to present organized life. Not only that, but everything during a tempest would be swept clean around the world. Nothing could stand. If much less, there would be no respiration possible, owing to the rarity of the atmosphere.

According to the constitution of the present vegetable kingdom the constancy of climate at the same place is a necessary condition for the welfare of the vegetable species fixed there. The climate may and does vary in different parts of the earth, but in the same place from year to year the mean annual heat and cold, cloud, sunshine, wind, calm, and other atmospheric conditions are the same. There may be a very hot season or a very cold season, but the yearly average always remains the same.

Had the earth an eccentric elliptical orbit, such as that of a comet, there would be no evenness in the climate of any place on its surface. The heat and cold would always be changing and varying from extremes of heat to extremes of cold and the composition of the atmosphere would be changed by the condensation of some of its gases by cold. This would be absolutely fatal to vegetable life as we know it. Indeed an average annual change of five degrees would kill all the vegetables now growing on our planet.

There are many varieties of climate on the earth, and we find that the animal and vegetable kingdoms are fitted for that variety in which they are located. Every zone of the earth has its peculiar vegetables. The tropics have their own vegetables, the temperate zones their own, and the frozen zones of the poles their own. Each species is exactly suited to its own surroundings and the nature of its climate. We have thus a variety in the laws of vegetable organization well adapted to the variety of climates; and by this adaptation the globe is clothed with vegetation and peopled with animals from pole to pole, while without such an adjustment vegetable and animal life must have been confined entirely to some narrow strip of the earth's surface. This is a wise dispensation of providence to diffuse life and well-being over the whole earth. Man is made for the whole earth and adjusted to every climate, so that wherever he wanders and sojourns on the globe he will find a plenteous support.

The average of the climate is constant at each place, but this average differs at different places. Many elements combine to produce the climate: The temperature of the earth, the air, and the water; the amount of watery vapor in the atmosphere; together with the winds and rains which control the equilibrium of the atmosphere. The effect of light and electricity must also be considered.

The mass of the earth is so constituted that it is slow to conduct heat and consequently slow to radiate it. If it were differently constituted, it might conduct and radiate heat very rapidly and thus the earth's surface would be entirely unbearable to animals and vegetables as now constructed.

Water is heated differently from solids. Solids are heated by conduction but water by convection. Water when heated expands and becomes lighter and the light water ascends and the cool water descends. Thus water is heated by a series of contrary currents, heated water ascending, and cold water descending. When water reaches a certain coldness it congeals and becomes ice. We have said that heated water is lighter than cold water, and that cold water descends to the bottom of lake and river. Now, if this law continued to be strictly true when ice would be once formed in lakes and rivers they would remain frozen for all time. The small amount of the surface that would be thawed in summer, would again freeze immediately at the first touch of winter and the waters of the earth would be forever a mass of ice. Besides destroying all fish life it would be very detrimental in many other respects to the creatures of the earth.

There is, however, an exception to this law. Water grows heavy and contracts with cold until we reach 40° Fahrenheit. After that, cold makes it expand and grow light. Ice is lighter than water and will float on the surface. So that when water nears the freezing point it ascends to the surface and remains on top and the freezing of the great bodies of water is averted. Here is a violation of a law which must be attributed to a great intervention of providence.

Most bodies, and particularly the metals are heavier in the solid than liquid state and the solid will sink in the liquid. There is thus a most beneficial exception in the case of water.

When water is highly heated it rises in vapor. We all know the beneficial effects of moisture in the atmosphere.

When we heat ice to produce water the

change is very slow and gradual. The heat becomes latent until the whole mass reaches the same temperature. The same is true when water is changed into steam. Otherwise all ice would melt instantaneously at the first touch of summer and produce awful torrents to sweep everything from the earth's surface. When sufficient heat would be applied to water it would also all instantaneously flash into steam. The slow and gradual change is really a violation of a law. Can anyone doubt that this violation was ordained by a wise and beneficent Providence?

Moisture in the air is very beneficial. But if the atmosphere were composed entirely of aqueous vapor the consequences would be fatal to the well-being of animals and plants. The waters near the equator, owing to the great heat of these regions, would rise in steam. This steam would have great rarity and elasticity. It would flow towards the cold polar regions and be precipitated as rain and snow. The sky of the equator would be cloudless, but in other latitudes there would be an unbroken shroud of clouds, fogs, rains and snows. It is a blessed thing for animal and vegetable life that the greater part of the atmosphere is composed of common air, a perfectly elastic fluid that cannot be condensed by cold or ordinary pressure. Air and water vapor combine to give the air better properties than either has alone. These two atmospheres of steam and air are constantly heating and cooling each other to the great benefit of plants and animals. The mixture of these two gases having different capacities for heat causes a constant upward and downward circulation of currents.

The most violent changes of weather, tempests and torrents, are oscillations about the average condition belonging to each place. The greatest oscillations are limited and transient. In the forces that produce any derangement of the weather there is a provision for making it short and moderate. This is a wise and thoughtful provision, as the mechanical laws of the atmosphere might have been such as to produce complete disorder and irregularity of the weather once the equilibrium becomes disturbed.

Electricity and magnetism, present in the earth and atmosphere, have their beneficial effects upon plant and animal life. The great magnetic and electric storms, too, help to purify the air and are of great benefit in preserving it from corruption.

Light is as necessary for the well-being of plants ordinarily as air or moisture. Deprived of light they may last for a time, but gradually the green or chlorofile disappears and white takes its place.

The chief effects of light regard the leaves. Under the influence of light the leaves of plants take carbonic acid from the air, appropriate the carbon, and set free sweet oxygen. Remove light and this process ceases, indeed, carbonic acid is given off from the leaves instead of being imbibed.

An important office of the air is the conduction of sound. In order that sound may fulfill its purpose in the economy of animal and human life it must have certain properties depending upon the nature of the air, such as differences of loudness, pitch, quality and articulation. It was indeed by a refined and skillful adaptation applied with a wise design that the air was made capable of conveying these differences at the same time, that the organs were made fit to produce them. Certainly a wise intelligence must have adapted the organism of the ear to the constitution of the atmosphere.

THE ATMOSPHERE.—The atmosphere considered as a whole with its combined uses is truly wonderful. It diffuses and tempers the heat of different climates. By a constant circulation of the watery part of the atmosphere between its upper and lower regions it is the means of forming clouds and rain. The blowing of winds from all quarters perpetually restores the equilibrium of heat and moisture. It is everywhere present and almost uniform in its quantity, and it is the most important material of the growth and sustenance of plants and animals. It is a means of communication between intelligent beings by being a medium of the propagation of sound waves. It is scarcely ever in the way. We put forth our hand and push it aside without being even aware that it is near us. Without air we should see nothing, except objects on which the sun's rays fell, directly or by reflection. It is the air that converts sunbeams into daylight, it diffuses light and fills the space in which we are with illumination.

Again the atmosphere is so organized that the ratio of its many ingredients has been preserved through all geological time, although circumstances might seem to point to a profound instability in their relations to each other. One of the ingredients in the air is carbonic acid gas or carbon dioxide. Its presence in the atmosphere is absolutely necessary for the preservation of organic life, as the plants depend upon it for their sustenance. To serve its purpose in the air it should exist in a certain proportion only of the whole weight of the atmosphere. This proportion must be not less than the one thousandth and not more than the one hundredth of the atmospheric mass. If the amount of this gas should become much less than it now is, vegetable life would cease; if much greater animal life would disappear. Now it is a well known fact and admitted by geologists that more than one hundred times as much carbon has passed through the air into the strata of the earth's crust since organic life began on the globe than has at any time existed in the atmospheric envelope. There must be skillful design here to preserve this very nice and accurate adjustment through such an extraordinarily long interval and under such a great variety of changes.

The atmosphere is chiefly composed of the two gases, Oxygen and Nitrogen, mixed together in the proportion of twenty-one parts of Oxygen to seventy-nine of Nitrogen. The other ingredients of the air, but in relatively very much smaller proportions, are carbonic acid and watery vapor, with traces of ammonia, carburetted hydrogen, the odoriferous matter of flowers and other volatile substances.

In the atmosphere the Oxygen and Nitrogen are not chemically combined, but merely mechanically mixed. Although in the atmosphere Oxygen and Nitrogen are simply mixed together, yet they are found in nature chemically united in five different combinations. Nitric acid or "Aqua Fortis," the source whence all the other compounds of these two gases are obtained, is a most deadly poison. If they were chemically combined in the atmosphere instead of being mixed mechanically, no animal life would be possible on the earth's surface.

Nitrogen seems to be present in the air solely to dilute the Oxygen. If Oxygen prevailed in the atmosphere in much greater proportion than it now does, animals would live too rapidly and soon expire and combustion would be supported too fiercely and everything inflammable on the whole globe would soon be consumed.

All the ingredients of the air are of different specific gravities, and really, in obedience to the laws of gravitation, should lie in layers or strata at distances from the earth corresponding to their separate densities and float one upon another as oil and water do when mingled.

According to the universal law of gravity the carbonic acid, being much heavier than the other gases, should lie in a layer at the bottom of the atmosphere and just over the earth's surface. It is computed that if all the carbonic acid were gathered together in the lower regions of the atmosphere it would form a stratum completely around the earth just thirteen feet high. Were this the case, as it should be if this universal law were obeyed, all animals would perish.

The deadly effects of too great an abundance of carbonic acid gas in the air is easily demonstrated. There is a valley in the island of Java where the soil emits so much of this acid that no animal can live there, and the birds that try to fly through it, fall down dead. There is a grotto at Pozzuolo, near Naples, into which a man can walk without injury, but in the atmosphere of which a dog becomes immediately asphixiated. The heavy gas emitted from the soil lies near the surface; the man escapes it, but the dog inhales it with deadly effects.

Because, however, of a violation of the universal law of gravity in the case of mingling gases, when two gases of different specific gravities are mixed together, they cannot remain separate, as fluids of different densities do, but diffuse themselves uniformly throughout the whole space which both occupy. Hence the composition of the air, wherever examined, over level plains or on the tops of the loftiest mountains is found to never vary.

Here again is a palpable violation of a most universal law for a most beneficent purpose.

LIGHT.—As the eye is made for light, so light must have been made among other ends for the eye. Reflection and refraction are indispensable properties of light; and it appears that it was necessary that light should possess such properties in order that it might form a medium of communication between man and the external world. Its power of passing through transparent media as the air is given it in order that it might enlighten the earth; its property of reflection to make colors visible; and that of refraction that it might enable the eye through its lenses and humors to discriminate figures and position.

HEAT.—The matter of heat is certainly a most vital one for the well-being of organized life on the earth. A certain limited range of temperature must be maintained upon the earth's surface to make living organisms possible. The nicety and delicacy of the adjustment necessary to sustain this limited range may be perceived when we consider the vast range in heat within the solar system. The temperature of the sun is in the neighborhood of a million degrees Fahr., that of the earth's interior probably above ten thousand degrees, and that of space four hundred degrees Fahr. below zero.

In this great scale of heat, organic life can occupy only the narrow space of about one hundred degrees, from zero to 100, or about the ten thousandth part of the heat variation afforded by the solar scheme.

Let us take a line a million inches or 16 miles long and let each inch represent one degree Fahr. of heat. If on that line 8 ft. of space be marked off near one end, this trifling part of the whole length will give us a representation of the proportions between the temperatures of the solar system and those in which organic life can be maintained. Should the heat of the earth's surface be materially changed from this narrow limit, the destruction of organic life would soon follow. But we know from fossils and other indices that organic life has existed on the earth during all geological time. So that during this vast period of time this delicate range of temperature has been wonderfully maintained amidst every fluctuation of circumstances.

Could blind chance unerringly select this one condition of a possible ten thousand? It would be folly to think so.

Looking around us on the earth and seeing every available point on its surface, the spaces of air, the depths of the ocean, the darkness of caverns and the surfaces of snow-fields teeming with life, it might appear to us that life has a power to maintain itself under a great variety of conditions, but when we really compare this little dot of an area occupied by organic life with the extent of the solar system alone, it would appear insignificant. Even scientists who deny a special creation of organisms admit that the bare existence of life depending upon conditions so limited, is a miracle. Since the beginning of geological times, there has in all probability never been a time when at the height of six miles above the earth's surface, even over the equator the heat necessary for animal and plant life has existed.

On the different planets as on the earth, life is limited to those worlds where a temperature a little above the freezing and below the boiling point of water is maintained. This is of absolute necessity seeing that solar irradiation is essential to the sustenance of organic life. In the face of this condition animal life is not possible in the other planets of our system. The outer planets are partially in a glowing condition and too hot for life. The heat of Mercury and Venus is too great, and their climatic vicissitudes too sudden and violent, and Mars entirely too cold, for the existence of life. We have the testimony of Linnæus that no vegetable could live on Mars, owing to its coldness and the extreme length of its year.

Thus organic life is necessarily limited to an almost inconceivably small part of the space and mass of the visible universe, and also to what we may fairly term comparatively a moment of time. To select the best in every instance, and out of such a vast number of possible conditions, argues a designing mind of infinite wisdom and foresight.

STABILITY OF THE SOLAR SYSTEM.—The orbit or path of the earth around the sun is almost a circle. This is important and cannot be due to chance. When a body is projected into space in the sun's neighborhood, it will form an orbit around the sun of some kind. If we suppose the matter left to chance, it would be infinitely against the circle, as there is but one circle and a possible infinite number of ellipses or ovals. The orbits of all the other planets, with the exception of the two smallest, Mars and Mercury, are almost circular. This cannot be chance. Mercury and Mars being small bodies, the ellipticity of their orbits can do no injury to the system. If the orbits of the great planets had this ellipticity the whole solar scheme would fall to pieces. The stability of the scheme is not due to chance, but to wise design and intelligent adjustment.

If the paths of the planets were drawn on a small scale, as upon a large board, they would be absolutely perfect circles. This utterly precludes the action of chance in their formation. Chance could no more do it than the accidental dashes of a brush in the hands of a blind man would make on a wall eight perfectly concentric circles. Moreover, if the earth's orbit was much more elliptical than it is, such, for instance, that the diameter would be as four to one, the inequality of heat on the earth's surface at different times would be so great as to destroy all living creatures.

"Of all the innumerable possible cases of systems, governed by the existing laws of force and motion, that one is selected which alone produces such steadfast periodicity, such a constant average of circumstances as are, so far as conceivable, necessary conditions, for the existence of organic and sentient life." (Whewell).

STABILITY OF THE OCEAN.—The stability of the ocean is another instance of the wise care of the Creator. The density of the earth is 5.55 times that of water and this establishes the stability of the seas. If the density of the earth were equal to Saturn's, which is less than a seventh part of the earth's, there would be an unstable equilibrium of the ocean, and the waters would rush to one side of the earth, completely deluging it.

One of the most beautiful hypotheses accounting for the present scheme of worlds around us, is the Nebular. It carries us back, according to its famous author, to a distant period when there existed in space a boundless abyss of luminous matter so rare as to be barely existing. But who placed this luminous matter in space, and who gave it luminosity? Who gave light and matter their salutary properties, so that this vapor should condense into beautiful planets and a bright central sun, instead of dark and barren stones? Certainly an all-wise Creator.

In the mechanical laws governing the universe of matter, we see wise design and provision for the welfare and stability of the system. The laws of gravitation might be different and subvertive even. The law of gravitation is that matter attracts in proportion to its mass and inversely as the square of the distance. Every particle of matter in the universe attracts every other inversely as the square of the distance. This attraction as the inverse square of the distance seems the best and wisest for the preservation of our system of an innumerable number of other possible laws. If the attraction were directly as the distance, the earth would lose its attraction for bodies on its own surface, owing to the great mass of the sun and the other planets. A body receiving the slightest impulse, would sweep around the earth perpetually as a satellite. Motion on the earth's surface would be impossible.

If the law had been inversely as the 4th, 5th, 6th power and so on, the earth's path about the sun would be a spiral, and it would be constantly either advancing or receding from the central luminary. Indeed if any other laws of gravity had been adapted by the Creator besides the present ones, the earth's path would be constantly changing to the great detriment of creatures and all regularity would be lost.

Gravitation itself is not necessarily an essential property of matter in the same sense as inertia, extension, mobility and impenetrability. Now if matter had not received this universal but not necessary property, what would become of our system of worlds?

One of the most striking features of the mechanical laws of gravity and motion is their great simplicity.

In the laws of motion we see very striking design. The first law of motion or inertia is that a body will perpetually remain in a state of motion or rest, unless acted upon by some extraneous force. There might have been a hundred laws instead of this simple one. The most perfect instance of this law is the rotation of the earth on its axis. The duration of this rotation has not changed the hundredth part of a second in historic times. If this law had been different, the motion of the earth on its axis would grow slower and slower, its revolution around the sun would become gradually less rapid, all motions would cease and soon every thing would come to rest. This beautiful law is evidently a wise design of Providence.

Another most beneficial property of matter is friction. Without friction we neither could stand nor walk, nor sit steadily, everything would be constantly sliding on the earth's surface, all would be in a condition of unstable equilibrium. Though friction is universal, yet it is not necessarily a property of matter. Friction does not stop the motions of the heavenly bodies. Thus where friction is beneficial as on the earth's surface it is active, where it would be prejudicial as in the heavens it is absent.

The structure of man, of itself so nicely and wisely adjusted to the inorganic laws and elements around him, and particularly that of his senses, is certainly evidence of the existence of a most beneficent Providence. If man's material parts speak of his Creator's wise foresight and beneficence, how much more strongly do his moral and intellectual parts, his mind and conscience?

The omnipotence of the Creator is shown in the vastness of the universe. The telescope discerns in both hemispheres nearly one hundred millions of suns, each of them, we know by analogy, is accompanied by many planets and satellites and yet space is so extensive, that it appears to be practically empty. It would require light traveling at the rate of 185,000 miles a second, three years and seven months to journey from the nearest fixed star.

The microscope shows infinity in another direction, in smallness. A single drop of pond water contains a score of living beings moving with prodigious velocity and all having perfectly organized systems.

The awful rapidity of the motions of the earth, the planets and the other heavenly bodies gives us another idea of the vastness of the world. The earth's motion of revolution around the sun, 19 miles a second, is 65 times greater than the highest velocity of a cannon ball. Others of the heavenly bodies move more rapidly still. The velocity of a comet in its perihelion swoop around the sun reaches 300 miles a second.

Who then, may we ask, gave matter and its elements their properties and laws? May we not confidently reply, God?

"The laws of material nature operate at all times and in all places. But a law supposes an agent and a power, for it is the mode according to which the agent proceeds, the order according to which the power acts. Without the presence of such an agent, of such a power, conscious of the relations on which the law depends, producing the effects which the law prescribes, the law can have no efficacy, no existence." (Whewell).

The greatest and wisest of modern scientists have acknowledged in unmistakable language the guiding hand of an all-wise personal Creator and Governor in the world.

"Who in this fair temple would place this lamp (the sun) in any other or better place, than there whence it may illuminate the whole? We find then under this ordination an admirable symmetry of the world and a certain harmonious connection of the motion and magnitude of the orbs, such as in any other way cannot be found. Thus the progressions and regressions of the planets all arise from the same cause, the motion of the earth. And that no such movements are seen in the fixed stars, argues their immense distance from us, which causes the apparent magnitude of the earth's annual course to become evanescent. So great, in short, is this divine fabric of the great and good God; this best and useful artificer of the universe." (Copernicus Lib. I, c. x).

"I beseech my reader, that not unmindful of the divine goodness bestowed on man, he do with me praise and celebrate the wisdom and greatness of the Creator, which I open to him from a more inward explication of the form of the world, from a searching of causes, from a detection of the errors of vision: and that thus, not only in the firmness and stability of the earth, he perceive with gratitude the preservation of all living things in nature as the gift of God, but also that in its motion, so recondite, so admirable, he acknowledges the wisdom of the Creator. But him who is too dull to receive this science, or too weak to believe the Copernican system without harm to his piety, him, I say, I advise that, leaving the school of astronomy, and condemning, if he please, any doctrines of the philosophers, he follow his own path, and desist from his wandering through the universe, and lifting up his natural eyes, with which alone he can see, pour himself out from his own heart in praise of God, the Creator; being certain that he gives no less worship to God than the astronomer, to whom God has given to see more clearly with his inward eye, and who, for what he has himself discovered, both can and will glorify God." (Kepler).

"This beautiful system of sun, planets and comets, could have its origin in no other way than by the purpose and command of an intelligent and powerful Being. He governs all things, not as the soul of the world, but as the Lord of the universe. He is not only God, but Lord or Governor. We know him only by his properties and attributes, by the wise and admirable structure of things around us, and by their final causes; we admire him on account of his perfections, we venerate and worship him on account of his government." (Newton, Principia.)

Copernicus, Kepler, and Newton are the great names which mark the progress of astronomy.

"While it is permitted us to speculate concerning the constitution of the world, we are also taught, perhaps in order that the activity of the human mind may not pause or languish, that our powers do not enable us to comprehend the works of His hands. May success therefore attend this intellectual exercise, thus permitted and appointed for us; by which we recognize and admire the greatness of God the more, in proportion as we find ourselves the less able to penetrate the profound abysses of His wisdom." (Galileo, Dialogues).

Galileo was the discoverer of the laws of motion, the founder of modern mechanics and the father of experimental philosophy.

" Nature has perfections in order to show that she is the image of God, and defects in order to show that she is only His image."

. . . .

" In almost all ages and countries the generality of philosophers and contemplative men were persuaded of the existence of a Deity from the consideration of the phenomena of the universe; whose fabric and conduct they rationally concluded could not justly be ascribed either to chance or to any other cause than a Divine Being." (Pascal, Pensies.)

" I am by all means for encouraging the contemplation of the celestial part of the world, and the shining globes that adorn it, and especially the sun and moon, in order to raise our admiration of the stupendous power and wisdom of Him, who was able to frame such immense bodies; and notwithstanding their vast bulk and scarce conceivable rapidity, keep them for so many ages constant, both to the lines and degrees of their motion, without interfering with one another. And doubtless we ought to return thanks and praises to the Divine goodness for having so placed the sun and moon, and determined the former, or else the earth, to move in particular lines for the good of men and other animals; and how disadvantageous it would have been to the inhabitants of the earth, if the luminaries had moved after a different manner." (Boyle, Essays.)

Boyle and Pascal were the persons mainly active in developing the more peculiar principles of the science of Hydrostatics.

The sciences that have reached their almost finished and complete form, in which an extensive and varied collection of phenomena, and their proximate causes, have been reduced to a few simple general laws, are Physical Astronomy, Mathematics, Mechanics and Hydrostatics. After these in order of development come Optics and Electricity.

Many of our multiple modern sciences are very crude and mascelent, and based upon some of the most erroneous and worthless guesses. They are called sciences simply through courtesy.

Clerk Maxwell, one of the wisest and greatest of recent physicists, said a short time before his death, that he had scrutinized all the agnostic hypotheses he knew of, and found that they one and all needed a God to make them workable.

CHAPTER IX.

ASTRONOMY OF THE BIBLE.

The Bible points out the chief attributes of the Godhead as unity, omnipotence, infinite wisdom, absolute unchangeableness, eternity and supreme goodness.

The teaching of astronomy concerning the attributes of the Creator of the material universe is in striking accord in this respect with the revelations of Scripture. Astronomy declares in clearest tones the unity of God. It is most evident that the structure of the physical universe has been planned and executed by one mind and one hand.

The same great laws of motion and gravitation govern matter everywhere in the cosmos. The matter of all the individual worlds of space is identical as far as being controlled by these grand forces.

These same identical laws govern the mightiest sun, the tiniest satellite, the massive planet and the evanescent comet.

The laws of gravitation and motion reach out into interstellar space, and direct there the conduct of the stars.

Many systems of binary stars are well known to be governed by these laws as recognized by us in our own solar scheme.

Newton verified his great discovery by showing that it first extended to the moon and afterwards to the other bodies of the system. Other great astronomers traced its action to the comets and stars. The orbits of the binary stars have been computed and the return of periodic comets most accurately predicted. So that in the vast universe with its myriad worlds there is unity of design, matter and law. One mind must have conceived the infinite plan and one mind wrought out its accomplishment.

Astronomy teaches the omnipotence of the framer of the universe. The work of dynamite in moving enormous masses and the rapid rolling of heavy trains impress us with an idea of power. But look at the evidences of power in nature. The earth is nearly 8,000 miles in diameter and yet it speeds along in its orbit around the sun at the rate of 19 miles a second, or with 65 times the rapidity of the initial velocity of a cannon ball.

The moon and other satellites, and the planets all have rapid motions in space. The mighty Jupiter, twelve hundred times the size, and three hundred and ten times the weight of the earth, is flying through space at the rate of eight miles a second.

The sun itself, thirteen hundred thousand times the size of the earth and 326 thousand times its mass, is rushing onward toward Hercules at the rate of four miles a second.

The binary stars before mentioned are revolving around each other with rapid speed, and the great suns of space are all traveling in widely extended orbits with high velocities. The bright Sirius, more than a thousand times the volume, and twenty times the mass of our own sun, is marching on at a rate of fourteen miles a second, and Canopus of the Southern Sky, the mighty King of suns, moves in its majestic course at a high rate of speed.

Nothing less than an omnipotent arm could guide the awful momenta of these vast worlds, for the hand that would stretch out even and stop the little moon would have to be all powerful. These mighty forces of the heavens truly speak of omnipotence.

Again, the celestial mechanism demands supreme wisdom in the Machinist. Nothing could point out more clearly the great wisdom of the Architect of the skies, than the discovery of the true system of the world by Copernicus. The old or false system with cycles and epicycles, centrics and eccentrics, with its cumbrous complexity, is in marked contrast to the real beauty and simplicity of the true system.

The beautiful laws by which our own scheme of worlds is controlled, and equilibrium preserved among so many great revolving orbs around a central mass, of itself alone demonstrates the wisdom of the Creator.

One of the most difficult problems of mathematics is that of the three bodies. When three bodies are launched into space, it requires the highest mental powers of the astronomer to compute their paths. When this is complicated with scores of other bodies, adding their mutual disturbances and multiplying perturbations, it requires infinite wisdom to give each its orbit so that it will hold its own path and not destroy or materially interfere with the paths of its neighbors. And still greater wisdom, if possible, is needed to marshal the mighty hosts of heaven, the hundred millions of rushing suns and their vast retinues.

The science of astronomy teaches that God is unchangeable. Without their constancy and invariability, Newton could never have discovered his law of gravitation, nor Kepler and Galileo their laws of motion.

The laws governing the universe of matter are absolutely invariable.

The time of the rotation of the earth on its axis has not changed a fraction of a second within historic times. So uniform are the motions of the moon and the planets that mathematicians can compute the times of eclipses and occultations to within a small fraction of a second.

The guiding hand of the celestial machinery has impressed it with its own immutability. It was thought for a time that the motion of the moon was changing, and that she was gradually but surely slipping away from her path. It has been found that this acceleration, as it is called, of the moon's motion is due to the united influences of the planets on the earth's orbit, widening it and making it more circular. But after a vast period this will correct itself, and the earth return to its original path.

Astronomy demonstrates that God is ubiquitous, or as the Scripture has it, that He fills immensity by His presence. As the power of the telescope grew greater and greater vast numbers of new stars were revealed, buried deeper and deeper in the realms of space.

Lord Rosse's mighty reflector discloses stars sunk so far in space that it would require light speeding at the rate of 185,000 miles a second, sixty thousand years to travel over the distance between them and the earth.

If the powers of the optic tube could be increased, stars still farther away would become visible. God's power reaches out to all these bodies. If his sustaining hand relaxed for an instant, all would be immediate chaos.

God's universe also points strikingly to his eternity. The physical universe is constantly changing; it had certainly a beginning, and will have an end. God's eternity can be shown from His works, since they are not eternal, only by analogy. The strata of the earth show the great time it has endured. The stars point to countless ages through which they have existed. There are stars so far in space, that if now destroyed, an inhabitant of the earth would not know of the disappearance for millions of years. The light beam from that annihilated sun would carry the news of its former existence for millions of ages. The telescope has demonstrated that many of the stars revolve around each other. One of these revolutions would require an immense time for its accomplishment.

The spectroscope tells us that the most distant suns have motions. All move around centers, and these again around other centers. It would take almost an eternity for the countless orbs of space to perform a complete cycle of the skies. If the creatures have so great an age, what of the Creator? Is not his existence an eternal one?

When we examine the laws of the physical world and see their beauty and beneficence, may we not also say that their framer has supreme goodness, since these laws have been selected from an almost infinite number of possible ones simply for their adaptation to the happiness and well-being of living creatures?

The great laws governing the universe of matter have been but recently discovered and understood by man. They were entirely unknown to the ancients. How could the writers of the Bible have discovered these attributes of God? May we not truly claim that they could only obtain this knowledge from divine revelation? From Inspiration? This will appear all the more evident when we know that the knowledge of these sublime attributes of God has escaped the learning and subtilty of the Greek, and the profundity of the Roman. Look at the puerile and often debased characters the Greeks and Romans gave their gods. Surely the Hebrew penmen were inspired.

Outside the Pentateuch there are but few allusions in the Bible to astronomical facts. In that wonderful book, there are indeed illustrations drawn from every department of human knowledge, from astronomy, optics, meteorology and natural history.

The astronomical allusions in the Book of Job are most extraordinary, when we consider its vast antiquity, and that the knowledge of the true system of the world and of the great laws of matter is comparatively of recent date. The questions asked in the Book of Job, under the circumstances, could be prompted alone by inspiration.

The ancients knew very little of astronomy. What little they did know for the most part came under a false system, the Ptolemaic.

The first astronomers, by universal assent, were the Chaldeans. They had a small catalogue of eclipses, discovered the "saros" or lunar period, and invented the zodiac. They determined the length of the tropical year, the equinoctial and solstitial points, and used the clepsydra, the gnomon and the hemispherical dial. This is a summary of their astronomical attainments.

Now the questions asked in Job are as apt and appropriate to-day, in the light of modern astronomy, the most perfect of the sciences, as they were in the days of Job. "Where wast thou when I laid the foundations of the earth? Declare, if thou hast understanding. Who hath laid the measures thereof, if thou knowest; or who hath stretched the line upon it? Whereupon are the foundations thereof fastened; or who hath laid the corner-stone thereof? When the morning stars sang together, and all the sons of God shouted for joy?" The Hebrew word from which "foundations" is translated, really means sockets or pivots, and the word from which "fastened" is derived, is best rendered by "made to sink."

This question is as unanswerable to-day in all the light of modern science, as in the time of Job. We might, indeed, answer that the world is sustained by gravitation. The laws of gravitation are known, but what gravitation is in itself, except that it is a manifestation of God's power, is as unanswerable now as in the days of antiquity.

Another sentence of Job: "He stretcheth out the north over the empty place, and hangeth the earth upon nothing." The real void part of the heavens is the north, it is a region of vacuity. As we approach the Galaxy or Milky Way, the heavens become richer and richer in star dust. And how true the expression, that the earth hangeth upon nothing?

Another interrogatory is: "Or who shut up the sea with doors when it broke forth, as if it had issued out of the womb?

When I made the cloud, the garment thereof, and thick darkness a swaddlingband for it, and broke up for it my decreed place, and set bars and doors, and said, hitherto shalt thou come, but no farther; and here shall thy proud waves be stayed?" The translators of the Bible found great difficulty in rendering into the vernacular scientific matters, of which they themselves and the age in which they lived, were not only ignorant, but even entertained false notions, and in some instances the sense of the original was a little bent to make it the more intelligible. Instead of "and broke up for it my decreed place" in the interrogation, the choicer rendering would be "established my decree upon it."

Now truly the adjustments by which the ocean limits are fixed, are most wonderful. If the earth had only the density of Saturn or Uranus, the water on its surface would be in a condition of unstable equilibrium and the slightest disturbance of the water would cause it to rush to one side. The earth would float on the water like a globe of cork, and be tossed and rolled over and over, and every part would be alternately submerged. Even should the earth retain its present specific gravity, if its orbit and those of the moon and planets were materially changed, tides could be produced, submerging successively the whole earth, and God's decree, "Hitherto shalt thou come, and no farther; and here shall thy proud waves be stayed," would be made void.

Again God asks Job: "Hast thou commanded the morning since thy days, and caused the day-spring from on high to know his place? That it might take hold of the ends of the earth. It is turned as clay to the seal, and they stand as a garment." God intimates to his servant that the day-spring has its appointed place, and never changes, that morning appears with unfailing regularity and precision. And, indeed, nothing can be truer. There is nothing in the universe more unchanging than the motion of the earth's rotation, the cause of the day-spring, of morning and night. For three thousand years it has not perceptibly changed. This is undying precision. The other motions that we know of in the universe vary. The motion of the earth in its orbit, of the moon, of the planets, of comets, are variable. This rotation is alone unchanging.

Should the velocity of this rotation grow greater or less, then disorder would enter the animal and vegetable kingdoms, for the temperature of the various regions of the earth would become deranged and destruction would inevitably follow.

Again, should this rotation grow slower, the waters would lose their present equilibrium, and the centrifugal strain being relaxed, they would rush madly upon the polar regions. Should the rotation be increased in speed, they would flow wildly towards the equator with the increase of centrifugal force. Hence the wonderful truth of the saying of Job: "He hath compassed the waters with bounds, until the day and night shall come to an end." If day and night should come to an end, the rotation of the earth would cease, and the waters would no longer be compassed with bounds.

"It is turned as clay to the seal, and they stand as a garment." This sentence might be interpreted as follows: The full blaze of the sun does not break forth instantly on its rising in the morning. The east is illuminated gradually and slowly. The atmosphere refracts the early beams of morning, bending them down, and curving them round the earth and moulding them to its form as clay to the seal, and standing about the earth as a garment of light.

Seeing that the ancients could know nothing about the true system of the world, and of the beauty and grand simplicity of its laws, the astronomic language of the Bible is marvellously apt and appropriate in the light of modern science. Besides the sublime simplicity of the language of Moses, the doctrines of the Persians, Egyptians and Greeks even concerning the structure of the world is ridiculous. "In the beginning, God created the heavens and the earth." The Egyptians ascribed the origin of all things to a winged egg, the Persians to a gloomy atmosphere, the Ionians to water, Epicurus to a fortunate gathering together of atoms, and Zeno to the energy of matter. All but Moses beg the original question. For whence came the egg, the wind, the water, the atom, and the matter?

The language of inspiration proclaims that "the heavens declare the glory of God, the firmament showeth his handiwork. Day unto day uttereth speech, and night unto night showeth forth knowledge." What language could be truer or more just. Look at the Galaxy, the Milky Way, our own universe with its hundred million suns and their retinues, all governed by the same simple and wise laws. Look far beyond our universe into other universes even more populous in suns than our own, and still on beyond the reach of any telescopic power or plummet, and we must confess that the heavens do indeed declare their Maker's glory.

God, wishing to illustrate the perpetuity of his covenant with Israel, says: "Thus saith the Lord, who giveth the sun for a light by day, and the ordinances of the moon and the stars for a light by night, if these ordinances depart from before me, then may my promise fail." This alludes to the invariability of the earth's rotation.

Again, the Hebrew prophet represents God as saying: "If heaven above can be measured, and the foundations of the earth searched out from beneath, then, and not till then will I cast off my people." "If ye can break my covenant of the day, and my covenant of the night, and that there should not be day and night in their season; then may my covenant be broken with my servant David."

"As the host of heaven cannot be numbered, so will I multiply the seed of David."

"If my covenant be not with day and night, and if I have not appointed the ordinances of heaven and earth, then will I cast away the seed of Jacob."

These passages simply intimate that the laws governing the physical world are unchangeable, which is absolutely true, as we have seen in the light of modern science.

That neither the stars can be numbered nor heaven measured is equally true, as is demonstrated by the telescope. The stars visible to the unaided eye have been accurately counted and are found to number between six and seven thousand. But the more powerful the telescope used, the greater the number of the stars revealed and the deeper space looks. Every new increase of telescopic power gives an increase in the number of stars rendered visible, and to the extent of space, until finally it is admitted that there is limit neither to the number of stars, nor to the expanse of the ether.

Again in Job: "Knowest thou the ordinances of heaven, and canst thou set the dominion thereof on earth." The heavens and the earth are always inseparably united in the language of the Bible, while in the records of all other primitive nations they are invariably treated as entirely separated. The latest teaching of modern science is that they are one and inseparable, governed by the same laws of attraction and motion.

The spectroscope shows that the stars are suns similarly composed as our own. Many elements found upon the earth have been discovered and identified by spectrum analysis to be present in the sun and stars, such as hydrogen, sodium, iron, magnesium and others.

Whenever allusion is made in the Bible to the physical heavens it would seem to have been written by one endowed with the most profound and accurate knowledge of the facts and laws of modern science. The astronomic illustrations in the Bible were most appropriate to the age in which they were written, and are equally, indeed, more strongly apt at the present time. This is not accident. It would be unphilosophic, indeed, silly to think so. It is the plainest and most tangible inspiration.

With equal truth and sublimity, the Psalmist exclaims: "O Lord my God, thou art very great; thou art clothed with honor and majesty; who coverest thyself with light as with a garment . who stretchest out the heavens like a curtain : who maketh the clouds his chariot: who laid the foundations of the earth, that it should not be removed forever. Thou coverest it with the deep as with a garment."

The two great astronomic miracles of the Bible, were the going backward of the shadow on the sun-dial of Ahaz ten degrees, and the stopping of the sun and moon for a whole day at Joshua's bidding.

A miracle is a violation of an established law of nature and can be produced evidently by the same power which made and still enforces nature's laws. One of the best known, best established and most universal of nature's laws is that of gravitation. Can God for special reason suspend this law? He certainly can, He having been the law's framer. If the historic testimony is sufficiently truthful, we must believe that God did it. But as we have seen already the Bible is a trustworthy historic record. But is it reasonable or philosophic for an unchangeable God to suspend an immutable law? This is the chief question. The use of miracles cannot be denied to God in the moral government of the world. Man has a free will. He can do or not do, or do the contrary. The physical elements of nature have no free will, and are controlled by invariably inexorable laws. God must govern the moral world differently from the physical. Whenever the religious education or moral elevation of man in God's judgment requires a miracle, a suspension of a physical law, God cannot philosophically be denied the use of miracles. It cannot be reasonably denied that a power competent to select and enact laws, can, if He pleases, suspend or alter them with this reservation, that the changes must be consistent with each other and with what remains. Reason teaches us that no power can accomplish an impossibility or what is a contradiction in itself, and God has given us our reason.

With regard to Joshua's miracle of making the sun and moon stand still during the space of a day, God could accomplish it in many ways. He might for instance stop the rotation of the earth on its axis. This would have the effect of arresting the apparent motion of the sun and moon. There would be no need of interfering with the revolution of the heavenly bodies. A sudden stopping of the earth's rotation would throw bodies on its surface into space with the velocity of the earth's rotation, according to the law of inertia or the first law of motion. However, the earth could be stopped slowly so that no shock would be perceptible. This could be accomplished in the space of a single minute. Besides the stopping of the earth's rotation, it would be necessary to sustain the equilibrium of the waters or to replace the effects of centrifugal force.

That God wrought the miracle we know from revelation. Why he did so, or how, we do not know.

Frequent attempts have been made to remove the miraculous character of the event and to explain by natural causes the standing still of the sun and moon at Joshua's command during the battle of Beth-Horon, by attributing the phenomenon to the effects of atmospheric refraction. The atmosphere certainly does refract the sun's rays passing through particularly near the horizon. It is a principle of optics, that light passing from a rare to a more dense medinm is bent towards the perpendicular, so that the sunbeams receive a curvature in passing through the air, the sun appearing in the line of the tangent to the curve.

The effects of refraction are, however, very slight, raising the sun vertically above the horizon, a distance about equal to its own apparent diameter. It would be absurd to think that natural refraction could keep the sun and moon still for a whole day. By interposing a substance of very extraordinary refracting powers, God could accomplish it, but this would be equally as miraculous as either the stopping of the earth's rotation, or the motion of the machinery of the heavens. One miracle is as easy of accomplishment to God as another.

Now it may be said, that if ever there was an occasion demanding from God a miracle to save his own chosen nation, it was this same battle of Beth-Horon. In vain would God have freed his people from the yoke of Egypt, and led them safely for 40 years through the desert, and assisted them to take Jericho, if now they failed at Beth-Horon. After the fall of Jericho, the five kings or sheiks of South Palestine had banded together to destroy the invading Israelites. The Gibeonites having gone over to Joshua, the Canaanites lay siege to Gibeon with all their forces, and Joshua hastened to its defense. Had Joshua lost the battle, his forces would be driven back across the Jordan, and be probably exterminated. This was one of the most decisive battles in all the history of the Hebrew nation, and put its very existence in hazard. Can we wonder that God interposed at the prayer of his servant to help his chosen people?

Joshua was at Gilgal when he received the message of distress from the Gibeonites, calling on him for immediate succor. During the night, he marched the twelve miles between the cities, and just about dawn stood under the walls of Gibeon. The Amorites were surprised and fled before the forces of Joshua. The hero having pursued the enemy to the crest of the hill at Upper Beth-Horon, six miles from Gibeon, and witnessing their precipitous flight down the road toward Lower Beth-Horon, began to fear that he would escape, and the victory would be an imperfect one.

It was now about nine o'clock in the morning, and the sun stood over Gibeon to the south east of Joshua, while the moon being in the 3rd or 4th quarter, stood west of him and over the valley of Ajalon. With outstretched hands the hero of Israel and with supreme confidence in his father's God cries out: "Sun stand thou still upon Gibeon; and thou, Moon, in the Valley of Ajalon. And the Lord hearkened to his voice, and the sun stood still, and the moon stayed until the people had avenged themselves upon their enemies, and it hastened not to go down about a whole day."

The retroversion of the shadow on the sun-dial of Ahaz is another of the astronomic miracles of the Bible. The atmosphere's property of refraction maintains the sun and other heavenly bodies sometime above the horizon, when they have actually set. Without interfering but little with the laws of nature, God could have interposed a refracing medium sufficient to (apparently) turn the sun's shadow backward through ten degrees of an arc. This, however, would require a miraculous intervention of God, but would be wrought out by the aid of natural laws and not through a violation of them.

The laws of the physical universe are unchangeable because God has made them so. In the sight of God, the moral towers infinitely above the material, and when Divine wisdom decides that he can add to the moral by the suspension of the laws of the material world, He certainly has reserved to himself the right to stay these laws.

Astronomers that believe in the eternity of the mechanism of the world and of matter, must be in constant alarm, for a chance accident to one of the myriad suns rolling in space, would bring them all tumbling together in chaos. Those that believe in God, have no dread of this kind, for they are not dependent upon chance for the safety of the world, and believe that God's goodness, power and wisdom regulate all things.

Many persons have also endeavored to explain the apparition of the Star of the Magi by a natural phenomenon, and thus rob it of its miraculous character. Kepler was the first to attempt this explanation in order to establish on a basis of certainty the exact date of our Lord's birth. He endeavored to identify a conjunction or near approach of Jupiter and Saturn with the appearance of the star of the Wise men.

Dr. Idler of Berlin, with not so disinterested and praiseworthy a motive as Kepler's, worked out with great care and really much plausibility this idea of Kepler's. Astronomers, however, have recently computed very accurately an ephemeris of Jupiter and Saturn, for the year 7 B. C.

There were three conjunctions of these planets in that year, and one of them occurred in December. At their nearest approach, December 4th, 7 B. C., the planets were separated by a space equal to double the apparent diameter of the moon. Consequently the planets could not possibly have appeared as a single star. And even if this did look as a single very bright star, they could not be said to appear to move on before the wise men, and stand still over any particular stable in Bethlehem. The stars, planets and comets are too distant to appear to stop or stand over any particular house or spot, as they will appear equally to be over every object in the neighborhood. Again, meteors are too ephemeral in their existence and too rapid in their flight to act as guides. This apparition of the star of the wisemen could have been no natural phenomenon.

These conjunctions of Jupiter and Saturn recur after intervals of fifty-nine years. This conjunction could have no extraordinary character for the Eastern astronomers of that time, as they must have been acquainted with the matter, seeing that they were able to compute the times of the solar eclipses very accurately.

The distinguished English astronomer, Pritchard, says: "But even supposing that the Magi did undertake this journey at the time in question, it seems impossible that the conjunction of December B. C. 7 can on any reasonable grounds be considered as fulfilling the conditions in St. Matthew. The circumstances are as follows: on or close to the 4th of December the sun set at Jerusalem about 5 P. M. Supposing the Magi to have then (or soon after) commenced their journey to Bethlehem, they would first see Jupiter and his dull companion one and a half hour distant from the meridian in a S. E. direction, and decidedly to the east of Bethlehem, which village is distant from Jerusalem by about a two hours' journey in a southerly direction. By the time they came to Rachel's tomb, the planets would be due south of them, on the meridian, and no longer over the Hill of Bethlehem, for as seen from Rachel's tomb that hill bears S. 13° E. The road then takes a turn to the east, and ascending the hill, terminates near to its western extremity. The planets would then be on their right hand and a little behind them as they entered the village; the "star," therefore, would cease altogether to go before them as a guide, and the case would be worse if they left the Jaffa gate at a later hour. Moreover, once on the hill, even if the star were not behind them as they proceeded along the village, it would be physically impossible for it to *stand over* any house whatever close to them, seeing that it would now be visible far away from the hill, on the side beyond it towards the west and the south, at an elevation of about 50° or more. As they advanced, the star would of necessity recede towards the west, and under no circumstances could be said even to appear to be over any house not distant by many miles from the place where they were. Thus the two heavenly bodies altogether fail to fulfill either of the conditions implied in the words "went before them" (*ώδῆγεν αὐτους*) or "stood over the house where the young child was" (ἐστάθη ἐπάνω), and the beautiful phantasm of Kepler and Ideler, which has fascinated so many minds, vanishes before the light of an astronomical examination." (Nature and Revelation, page 253.)

The star of the Magi was no ordinary astronomic phenomenon, but must have been, as the Scripture intimates, a supernatural and divinely appointed messenger of the Most High.

Chapter X.

OPTICS OF THE BIBLE.

Optics is one of the best developed of the sciences, and as far as its physical conditions are concerned, has acquired a considerable degree of completeness. It is one of the few sciences in which an extensive and varied collection of phenomena, and their proximate causes, have been reduced to a few simple general laws.

Optics is preëminently a modern science and largely owes its development to Young and Fresnel.

The ancients did very little in the field of optics, and their acquaintance with it was confined to a knowledge of the law of reflection. The ancient philosophers, with the exception of Aristotle, believed that rays proceeded from the eye to the object, instead of from the object to the eye.

The Arabian astronomer Alhazen appears to have been the first, in the 11th century, to perceive that vision is produced by rays of light proceeding from the object to the eye.

Ptolemy was acquainted with the fact that the rays of light passing through the atmosphere were bent or refracted.

During the middle ages no addition was made to this science.

Jansen, Galileo and Kepler, by working and experimenting with lenses, made some slight advances in optics.

From this time forward, the science began to advance slowly but steadily under the efforts of Snell, Descartes, DeDominis, Mariotte, Boyle, Barrow, Fermat and others.

The gigantic efforts of Newton gave an immense impulse to the study of this science. Newton's labors in the field of optics were herculean. Newton was the greatest advocate of the corpuscular or emission theory of light, although Descartes, the founder of modern mechanical philosophy, was its originator.

Among the most obvious properties of light, discovered by observation, are its divergence equally in all directions from a luminous center and its transmission in straight lines.

Its velocity is a very rapid one indeed, and has been determined principally by the method of reflecting mirrors and the observations of the eclipses of Jupiter's satellites.

Roemer, in 1675, made the first estimation of the velocity of light by means of observations on the eclipses of Jupiter's satellite. He found by this method a velocity for light of 190,000 miles a second.

Fizeau, in 1849, first used reflecting mirrors to compute the velocity of light. This method gives 185,000 miles a second as light's velocity, and these figures are now regarded by scientists generally as a very close approximation.

Like that of gravitation, heat and sound, the intensity of light diminishes inversely as the square of the distance from the luminous center. All surfaces reflect more or less light, even those through which it is most readily transmissible.

When a ray of light falls upon any surface, the angle which it makes with the perpendicular or normal to the surface at the point of incidence is called the angle of incidence; and that which the reflected ray makes with the perpendicular, is called the angle of reflection. In the reflection of light, the incident ray, the perpendicular to the surface at the point of incidence and the reflected ray, lie in the one same plane, and the angle of reflection is always equal to the angle of incidence.

When a ray of homogeneous light is incident on a refracting surface, the angle which its direction makes with the perpendicular to the surface is called the angle of incidence, and the angle which the refracted ray makes with the perpendicular is called the angle of refraction. The incident and refracted ray lie in the same plane as the perpendicular at the point of incidence, and upon opposite sides of it.

Snell's law of the sines is that the sine of the angle of incidence, whatever that angle may be, bears to the sine of the angle of refraction a constant ratio dependent only on the nature of the media between which the refraction takes place, and on the nature of the light. This constant ratio just mentioned, is called the coefficient or index of refraction, and will have a certain value, for instance, for refraction from vacuum into glass, another from glass into water; it will also have one value for red light and another for green, blue, yellow and so on. This coefficient is greater than unity when refraction takes place from vacuum into a medium, and in general is greater than unity when the refraction is from a rarer into a denser medium, and less than unity when the contrary happens. Thus, from air to water, the coefficient of refraction is $\frac{4}{3}$, from air to diamond $\frac{5}{2}$, from water to crown glass $\frac{9}{8}$, and from crown glass to diamond $\frac{5}{3}$; while from crown glass to air it is $\frac{2}{3}$, and from water to air $\frac{3}{4}$, and so forth.

The angle of incidence may vary from 0° up to 90°, and the angle of refraction cannot exceed 90°, because this is the whole space between any surface and a perpendicular to it. Hence, for light going toward the rarer medium, there will be a limit of the angle of incidence beyond which no angle of refraction can be found sufficiently large. Rays meeting the surface at an angle greater than this limit, cannot pass the surface. There is a mathematical impossibility, and hence a physical; and the light is wholly thrown back into the medium, or totally reflected.

These are the best known and most general properties of light. There are many other properties of light, some of recent discovery, such as polarization, double refraction, aberration, chromatic aberration, diffraction, dispersion, interference, and so on, which need not be considered here.

Two rival theories, purporting to account for the different phenomena of light, have for a long time stood side by side. Each theory claimed great names among its supporters and very bitter partisans. The great Newton stood the father of the one, and Huygens that of the other. The theory of emission, or the corpuscular theory of Newton, claims that light consists of luminous particles thrown off from the light source, and so minute as to be practically imponderable. These particles impinging on the organs of vision, produce the sensation of light. In this theory the colors of light depend on the velocity of its transmission. It regards reflection as analogous to the rebounding of elastic bodies, while to explain refraction, it assumes that there are interstices in transparent bodies, to allow of the passage of the particles of light, and that these particles are attracted by the molecules of bodies, their attraction combining with the velocity of the particles of light to cause them to deviate in their course.

The particles of light in this hypothesis are capable, like elastic balls, of bounding from or being reflected by surfaces; and the production of colors is explained by assuming that a rotary motion is given to these particles under certain circumstances.

The second or undulatory theory, proposed by Hooke and advocated by Huygens, supposes the existence of an imponderable cosmic or luminiferous ether, reaching out into interstellar space and filling the interstices of bodies, all of which, however hard or seemingly impenetrable, are now known to be more or less porous. Vibrations in the substance of this ether, transverse or perpendicular to the direction of the ray, are, according to Huygens and his disciples, the origin of light.

The color of light in the undulatory theory depends on a wave-length or on the period of a wave.

It was the explanation of the principle of interference, that formed the most decisive reason yet known for adopting the undulatory in preference to the emission theory of light.

Interference is the effect which rays of light, after being bent or diffracted, produce on each other.

Fresnel in his elegant, lucid and most instructive experiment on Interference, employed two mirrors placed together at a very obtuse angle, a very little less than 180°, and reflected from their surfaces upon a screen light from the focus of a lens, in such a manner that on reaching the screen, some of the undulations of two converging rays should correspond and intensify one another, while others should be separated by half a wave length and destroy one another.

If two luminous waves, according to the undulatory theory, simultaneously impel a molecule of ether, its motion will be the resultant of the original impulses; and if the two motions, as in the case of diffraction, be nearly in the same direction, the resultant will be nearly their sum; if opposite, their difference. Thus, when a particle has begun to vibrate from the action of a luminous wave, and if, while in motion, another wave impinge upon it, the result will be increase of light, if the motion of the second wave conspire with that of the first; but a decrease, if they oppose each other; and total darkness, if, while opposing, they are equal in velocity.

If the second wave impinge upon the molecule of ether, already vibrating under the impulse of a first wave, after it has accomplished one or more vibrations and has returned to its original position, the two waves will evidently conspire together, and produce more violent motion; but if it impinge on the molecule, when the latter has only accomplished half a vibration, then the wave will oppose the particle's return to its original position; thus producing diminution of motion, or, if equal, rest.

In the former case, the intensity of light is increased; in the latter, diminished; and if the undulations are of equal velocity, the light is doubled in the first case, and destroyed in the second.

The corpuscular hypothesis absolutely fails to explain interference. The brilliant experiments of Young and Fresnel on this subject of Interference have won a complete triumph for the undulatory theory. Its truth is now universally admitted by physicists. It has not only satisfactorily accounted for all the phenomena of light, but has been the means of discovering new phenomena, so that its soundness may be said to rest on evidence similar to that which we have for the theory of gravitation.

Owing to the great name of Newton, the theory of emission seemed for a long time to be all but established.

During the apparent triumph of the emission theory an objection that appeared insurmountable was raised by scientists of this school against the language of Moses in Genesis. In the first book of the Pentateuch, God is represented as making light anterior to the sun. This could not be under the corpuscular theory, seeing that light would be produced by particles issuing from the sun. Consequently the sun should exist before we could have the sensation of light. During the sway or vogue of the emission theory, this statement of Moses was regarded by infidel scientists as so absurd, that they declared that it would of itself prove Moses an impostor. But it is now known that it is in perfect accord with the undulatory theory and consequently with the most advanced ideas of modern optics.

And so the old objection that formerly seemed so overwhelming, has served only to strengthen the truth and luster of the Mosaic account. This indeed should be a warning to scientists. They should not pass too rapid a judgment against a record that has stood the attacks of so many centuries. Thus has Scripture preceded the discoveries of the learned.

In the Book of Genesis, Moses represents God as saying: "Be light made. And light was made. And God saw the light that it was good: and he divided the light from the darkness."

Col. Robert G. Ingersoll objects very vehemently to the correctness of this declaration of Moses that God divided the light from the darkness. It is one of his chief objections to the truth of the Pentateuch, and the Colonel refers to it on almost all occasions.

In his lecture on the "Mistakes of Moses," the Colonel, (page 3) says: "The next thing he (Moses) proceeds to tell us, is that God divided the darkness from the light; and right here let me say when I speak about God, I simply mean the being described by the Jews. There may be in immensity some being beneath whose wing the universe exists, whose every thought is a glittering star, but I know nothing about Him, not the slightest, and this afternoon I am simply talking about the being described by the Jewish people. When I say God, I mean Him. Moses describes God dividing the light from the darkness. I suppose that at that time they must have been mixed. You can readily see how light and darkness can get mixed. They must have been entities. The reason I think so, is because in that same book I find that darkness overspread Egypt so thick, that it could be felt, and they used to have on exhibition in Rome a bottle of the darkness that once overspread Egypt. The gentleman who wrote this, in imagination saw God dividing light from darkness. I am sure the man who wrote it, believed darkness to be an entity, a something, a tangible thing that can be mixed with light."

The eloquent and glittering Colonel is very fond of bombast. All his objections against religion are dummies arrayed in bombast and the raiment forms ninety-nine per cent of the whole.

Darkness is a negative quality. It is not an entity. It is merely the absence of light. Cold is also a negative quality. It is not an entity. Cold is simply the absence of heat. We know that cold, nevertheless, can be divided or separated from heat. It is done every day. Similarly darkness can be divided or separated from light. It is done every day when we close our doors and window blinds, and when the earth rotates on its axis, giving twelve hours of light on an average, and twelve hours of darkness. We all speak of separating light from darkness. Custom has made the mode of expression universal and correct.

In another way God divided the light from the darkness by gathering together and condensing into great centers the nebulous matter of space (according to the nebular hypothesis) and creating great luminous suns, and leaving other parts of space in dense darkness.

Speaking of the darkness of Egypt as being sensible to the touch is a very common metaphor. In alluding to the bottle of darkness kept in Rome, the brilliant Colonel exposes his gullibility. A Fuegian free from prejudice would not believe that little ditty.

In the wonderfully sublime book of Job, the Almighty is represented as asking the patriarch: "Where is the way where light dwelleth, and as for darkness, where is the place thereof, that thou shouldst take it to the bounds thereof, and that thou shouldst know the paths to the house thereof? Knowest thou it because thou wert then born, or because the number of thy days is great?" Here are enquiries of the most astonishing character regarding the dwelling place of light and darkness, the bounds of each, and the path to the house of light.

These questions are truly wonderful in the light of modern science. They are as unanswerable now as in the days of Job, when neither the corpuscular nor undulatory theory was known. We can as little say now as persons in the time of Job could say where is the limit beyond which light has never passed, and, gazing into the dark abyss beyond, declare there darkness reigns.

Every new increase of power of the telescope has revealed new stars buried deeper and deeper in the abysm of space. The leviathan of Lord Rosse discloses stars so far away from us, that it would require 60,000 years for light traveling with its awful velocity to cross the fearful chasm.

We know from analogy that greater instruments would reveal greater depths of space, lighted with now unknown suns. You may look into points in space appearing all blank, deep and dark to the unaided vision, and turn then the telescope upon them and you see thousands of blazing orbs. We may use power after power of telescope and gaze into space, and behold black spot after black spot illumined without reaching a limit. We cannot then pierce the boundary of light. We cannot penetrate the domain of darkness.

Wonderfully just and truthful is the sublime language of Holy Job, and the light of modern science has particularly flooded with meaning this astonishing passage.

Chapter XI.

RESULTS OF GEOLOGY.

(*Agencies of Structure.*)

Geology is one of the sciences said to be in conflict with the Pentateuch. Some contend that the order of creation as set forth in Genesis, is contradicted by the teachings of Geology; that the fossils found in the earth's stony bosom favor the theory of evolution by indicating that man and the higher animals have all been transmuted by slow gradations from the Monon, an animal of one cell, the lowest form of life; that deposits deep down below the earth's surface, containing skeletons and relics of cave-men and lake-dwellers, show man's antiquity to be vastly greater than that of Biblical chronology; and that even the fossil itself of prehistoric man has been unearthed.

What Geology teaches concerning the age of the world and the order of creation, will be first considered, and later under the headings of Biology, Anthropology, and the Antiquity of Man, the questions of evolution and man's age.

The crust of the earth is composed of a number of rocky layers or strata. These strata have been laid down or deposited successively at different periods of time. Each one of these rocky layers contains fossil remains of quite different and distinct species of animals and plants. Geologists are enabled to tell by the character of the fossil remains found in the various strata, the order in which the animal and plant species appeared upon the globe.

Hence the great importance of determining as accurately as possible the precise succession of the rocky layers, and the fossil fauna and flora which they contain.

It will be found that the order of the creation of the animal and vegetable kingdoms voiced by Nature herself, far from being contradictory to, is really in essential harmony with, the words of Genesis.

That Geology demands a very high antiquity for our world can be easily conceded. This will in no wise impugn the veracity of the Mosaic record. The days of Genesis, as previously mentioned, are regarded in different senses by different commentators of Scripture. The church has made no official declaration on the subject.

It is true that some commentators claim that the days of creation must be understood as days of only twenty-four hours each, but other great commentators regard them as epochs, and others again as ordinary days, but interpret the expression "In the beginning" of Genesis as a vast period of indefinite length.

One of the most peremptory claims of geologists is that of a vast age for the world. Let us examine the grounds upon which this claim rests, and see how worthy it is of our credence.

The age of the earth is recorded on the stony leaves of its crust. Hence the great importance of examining carefully this crust and of studying the nature of the agencies that combined to form it. If we are convinced by the soundness of the reasons adduced by geologists, that the age of our globe is very great, we are at liberty to follow two legitimate interpretations of scripture, admitting of a high antiquity for the world.

Geology, as its name intimates, is a discourse concerning the earth, and in its usually accepted and limited sense is a history of the conditions of our globe and its inhabitants in the past. Geology is the geography and natural history of the bygone ages of our planet.

The surface of the earth as it now appears has been shaped, generally, by slow and gradual processes. The self-same forces of formation are now in active operation under our eyes, and it is principally by studying crust structure now actively at work that we will be able to reason by analogy back to the means and methods of earlier similar formations.

The first step of the practical geologist, then, is to study closely the causes and processes of crust structure now going on on every side.

The principal agencies now at work in shaping the form of the earth's crust are atmospheric, aqueous, organic, and igneous. By observing the operations of these agencies now, we may be able to understand the accumulated effects of their work through inconceivable ages in the past.

Atmospheric Agencies.—The chief effect of the atmosphere on the earth's crust is the formation of soil. Soil is formed from rock. Soil is the result of the rotting down of rocks under the slow action of the atmosphere. The ingredients of the atmosphere in soil-making are oxygen, carbon dioxide, and water as moisture.

The moisture of the air falls upon the rocks in great abundance as rain-water, containing in solution carbon dioxide and oxygen. Rain-water falling upon the surfaces of rocks and penetrating into their interstices, rots them and forms soils.

Sometimes the soils remain resting on the rocks where they are formed; are sometimes removed to other places, as from hills to bottom-lands; and again carried by currents to great distances.

The depth of the soil on the earth's surface is far from being uniform. In many places the soil is carried away by rain-falls and streams almost as rapidly as it is formed, and again some rocks rot more rapidly than others. On level plains the soil is very deep, as the process of rock-rotting has been going on uninterruptedly for untold ages. Again rocks are often filled with joints and fissures, and the water penetrates to great depths and consequently the process of soil-making reaches down to great distances below the surface. In general, however, it may be said that the process of soil-making is extremely slow.

Some parts of all rocks are soluble in rain water and some are not. The soluble parts are slowly dissolved under the action of the atmospheric water and the rock breaks down into soil. The above is the chemical effect of rain-water in forming soils, but in high latitudes and mountainous regions, atmospheric water disintegrates rocks mechanically. In wet seasons, rain-water penetrates into the fissures of rocks to great depths, and freezing, breaks asunder the massive blocks into fragments, and these again into smaller portions until all crumble into dust.

Atmospheric water acts chemically upon the rocks, decomposing them and producing soil. But water acts mechanically upon the crust of the earth as a soil remover or surface leveler. The mechanical agency of water in soil-removal may be regarded under the heads of river, ocean and ice; and each of these agencies may be considered in the light of erosion, transportation and deposit.

Atmospheric water is constantly falling on the earth's surface in the form of rain. A portion of this water sinks into the earth, decomposing rock and forming soil, and then comes up again to the surface through the medium of springs. Another portion of this rain runs along the earth's uneven surface and down the slopes of hills, cutting furrows and forming rills. Rills unite and form rivulets and streamlets, and these again uniting, form rivers.

All running water carries away soil in more or less abundance according to its size and velocity. The rivers unload their freight of soil and fragments of rocks in lakes and seas. Thus all the lands of the earth are being constantly washed away and carried to the sea by the action of rain and rivers. It is computed that all land-surfaces are thus being cut away by rain and river erosion at an average rate for the whole earth of one foot in 5,000 years. And as the mean height of land over the ocean for all the earth is 1200 feet, it would require 6,000,000 years to perfectly level the globe.

So much for erosion, now for the transportation by water. It is well known that all rivers carry along mud and earthy materials in more or less abundance. The weight of the fragments of stone or earth movable by running water increases at the rate of the 6th power of the velocity of the current. Thus, if the velocity of a stream be increased ten times, its carrying force will be multiplied one million times. If, then, a current be carrying all it can, the least check to its velocity will cause deposit, and the least subsequent increase will enable it to again take up deposited material.

Sorting Power of Water.—If we throw

a few handfuls of earth into a basin of water and allow it to settle for a time, and then gently pour off the water, it will be seen that the materials of the deposit are perfectly assorted. The coarse fragments will be found at the bottom, and the successive layers will be found finer and finer as we ascend until only very fine mud is seen at the top.

If the loose earth had been thrown into running water, a similar but really more perfect assortment would be seen. The very coarse material would be found high up the stream, and as we advanced downward, the deposits would be found to be finer and finer. Pebbles are found only in beds of rapid torrents, and fine mud in those of slowly moving streams.

Stratification.—Owing to the sorting power of water, the bottoms and banks of lakes, rivers and seas are made up of layers of materials of different degrees of coarseness, or, in a word, are found to be stratified. After every rain-fall an amount of earthy matter is borne into the lake or sea, and is finally deposited in layers, the coarsest particles on the bottom, and the finest on the top. The mud carried into rivers by rivulets and after rains is sorted also, but in a different way, the coarser particles being deposited higher up the stream and the finer lower down.

General Law.—"We may therefore state it as a general law that all deposits in water, whether still water, as lakes and seas, or running water, as rivers, are stratified, and, conversely, that all stratified materials, wherever we find them, whether near water or high up on the tops of mountains, and in whatsoever condition we find them, whether as sands and muds or as hard stone, if the stratification be a true stratification, i. e., the result of sorted material, has been deposited in water. Upon this very simple law, nearly the whole of geological reasoning is based." (Le Conte's Geology, page 21.)

Rivers ordinarily rise in mountainous regions and flow along in their lower course through flat plains. In flood seasons, the rivers overflow their banks and the area subject to the overflow is called the flood-plain. The flood-plains of some of the great rivers of the world are very extensive. The whole of Egypt is the flood-plain of the Nile. After every overflow the sedimentary deposit becomes higher and higher.

The thickness of the Nile deposit is computed at forty feet in depth. Nine feet have been placed there within 3,000 years. The statue of Rameses II, is covered from its base to a height of 9 feet with the sediment of the Nile. This is the oldest monument of civilization in the world. This then—3,000 years—is the highest antiquity that can be possibly claimed by any monument of civilized man.

At the mouths of all great rivers vast quantities of mud are dumped into the sea. This dumping process going on for ages, gradually reclaims a portion of land from the empire of the ocean. The lands formed in this way at the mouths of rivers are called deltas. These deltas are often very extensive; that at the mouth of the Nile containing 10,000 square miles, and the common one of the Ganges and Brahmapootra 20,000 square miles.

In great rivers flowing long distances, the coarse material of their saturation is all dropped high up the stream and only the fine mud reaches the sea, and being slowly deposited, the stratification of deltas is almost horizontal. When rivers empty into oceans having great tides, deltas are not formed, on the contrary, not only is the sediment of the rivers all borne out to sea, but also great portions of the beds and banks are carried seaward, causing estuaries. Deltas are only found at the mouths of rivers emptying into tideless seas.

Agency of the Ocean.—Another great factor in land erosion, although much less in its aggregate effect than rivers and rains, are the waves and tides of old ocean beating against exposed shores.

The eastern coast of England is disappearing at the rate of 3 to 5 feet yearly, many islands in the German Ocean have entirely vanished, Heligoland is nearly gone, and the coast of Norway is being eaten rapidly away. It must be said, however, that the tides and waves of ocean add to the land in many places. In fact what is lost to one place, is carried to and deposited in another place.

Land made by the ocean waves has characteristic marks to distinguish it. The material is usually round-grained sand, shingle or gravel; and the layers irregular and inclined, are often impressed with rain-drops, animal tracks and ripple marks. Old shorelines of past geological epochs are recognized by these marks, and are often found now in rocks far inland and high up on mountain sides.

GLACIERS.—Glaciers have had quite a strong agency in sculpturing out the earth's surface. Glaciers are ice-rivers running slowly down the sides of snow-capped mountains into the valleys beneath and carrying along with them immense quantities of debris of every kind, great fragments of stone, loose earthy matter, vegetation and tree-trunks.

ICEBERGS.—In high latitudes glaciers run out into the sea, and portions are broken off by the waves and borne away upon the ocean currents. These floating fragments are icebergs. They are loaded with debris of every kind, and reaching warmer latitudes, are melted, depositing their burdens upon the bottom of the sea. In this way they are a factor in shaping the earth's crust.

Aqueous agencies are principally mechanical, but they are also partially chemical. Rocks are dissolved by water and the soluble material, soil, is brought to the surface by springs.

All rain water has carbonic acid gas (CO_2) in solution. Water thus impregnated, entirely corrodes and dissolves limestone rock. Thus, in many countries whole strata of limestone have been eaten away, leaving vast caverns filled with limestone drippings in the form of pillars, pilasters, stalactites and stalagmites. Mineral springs carrying to the surface soluble mineral water, deposit it. Immense deposits of this kind are found in many countries, covering miles in extent, and are hundreds of feet thick. In this way have been formed vast quarries of travertine and calcareous tufa, great veins of silica, sulphur and iron oxides; and by the drying up of mineral lakes, immense beds of salt, alkalines and borax.

Organic Agencies.— Organic agencies

have performed an important part in the formation of the earth's crust. In one way these agencies are the most important of all, as the fossils of animals and plants found embedded in the strata of the earth's crust have written the most delicate and truest history of our planet.

Peat-bogs and peat-swamps are very extensive in cool, moist climates. These bogs and swamps are the accumulations of disintegrated vegetables, rushes, shrubs and trees during vast ages. Their composition is chiefly carbon, as most of the gaseous elements of the original plants have been lost, passing into the atmosphere.

Peat is often found in the deltas of great rivers in layers, alternating with river-silt. The plants and trees were borne down in great floods and deposited in the delta and then covered up by the silt coming on later.

This peaty substance, when covered deeply with mud and sand, and subject to great pressure, has in many places been converted into immense coal-seams and great beds of lignite.

Corals.—A large area has been reclaimed from the sea and added to the land as coral reefs and islands. These reefs and islands are really immense accumulations of limestone, deposited by millions upon millions of soft polyps, actiniæ, sea-anemones or zoöphytes.

Coral is formed by the secretion of calcareous matter or limestone from sea water by these little animals. The zoöphyte has no organ of sense. They can multiply by buds and eggs. They are of the type of the radiates, have a cylindrical body with a mouth at one extremity surrounded by tentacles.

Coral formation is of great interest to the geologists also, because it is an evidence of crust movements on a grand scale.

The polyp takes sea water into its mouth by means of the tentacles, and digests lime carbonate.

Reef-building corals will grow only under restricted conditions. They will not thrive in an ocean temperature of less than 68° Fahr. On the shores of Florida, the Bahamas and the Bermudas they grow in a high latitude owing to the presence of the warm Gulf Stream.

They will not grow in a depth of ocean beyond one hundred feet. They must have salt water, as they are killed by mud and by fresh water. They thrive best where exposed to the waves of old ocean.

In the Pacific Ocean there are three kinds of coral reefs; fringing, barrier and circular (atolls) reefs. About high volcanic islands we find fringing reefs. Corals build around the islands, limited outward by depth and inward by the shore and upward by sea-level. The corals build a platform or fringe around the island.

Around some of these volcanic islands there may be no reef, but at a distance of from five to fifteen miles is often found a rampart of corals going completely around the island and separated from it by a channel many fathoms deep. There are many circular reefs or atolls in the Pacific. These reefs seem to have grown up from the great sea-bottom without the aid of an island. The reef encloses a lagoon of still water of an irregular circular form. There is neither volcanic island nor land of any kind in the interior.

Whence came the barrier reefs and atolls? Darwin's theory is the one generally accepted by geologists. He claims that the atolls and barrier reefs were at first fringing reefs. That the bed of the Pacific has been gradually sinking, carrying the volcanic islands with it, forming first barrier reefs, and later, atolls. If the ocean bed had subsided too rapidly, the corals would have been carried down below a depth of one hundred feet and drowned. The subsidence was just as fast as the coral ground grew upward, and thus the living corals kept themselves above the hundred feet limit. In the mean time, however, the island was sinking with the ocean bed, and gradually separated from the fringe of corals, and grew smaller and smaller until it formed the barrier reef and finally disappeared and left the atoll.

The amount of sea-bottom subsiding is computed at 12,000,000 square miles. The amount of (volcanic and coral islands) lost or carried down below the ocean surface, is estimated at many hundred thousand square miles. The amount of the actual subsidence is placed at 10,000 feet. The rate of sinking cannot exceed the rate of coral growth, or the corals would have been all drowned. The rate at which coral ground rises, is placed at one quarter to one half inch yearly. Thus, for a subsidence of 10,000 feet, it would require in the neighborhood of 500,000 years.

An ocean bed of many millions of miles in area has sunk down several thousand feet. This sinking has been going on for immense ages and is still going on. This vast downward movement demands an upward one to maintain an equilibrium of the earth's crust. The western portion of the American Continent has been gradually elevated about 20,000 feet during the present and latter part of the Tertiary epoch. It is very likely that the sinking of the Pacific ocean floor and the elevation of the American Continent are connected together in preserving the crust equilibrium of our planet.

Besides coral deposits there are also immense limestone deposits from Molluscous and Microscopic shells.

The agencies thus far considered, are levelling ones, and tend to cut down the land and fill the ocean or make a universal ocean.

There is, however, an other class of agencies called igneous, the tendency of which is to upheave or elevate the earth's surface unevenly. The actual shape of the earth's crust is the resultant of these forces of leveling and upheaving.

There is a dispute between astronomers and geologists regarding the interior heat of the earth. Very many geologists claim that the earth's interior is a molten mass of fire. Astronomers claim that the mechanical principle of tides requires a rigidity in the earth equal to that of steel.

All agree, however, that there are vast quantities of heat within the earth. This heat causes volcanoes, earthquakes and vibrations of the earth's crust.

VOLCANOES.—Taking the whole globe, volcanoes are very numerous. Humboldt counted 225 as active during the past century. Volcanoes most frequently are found in islands of the ocean, or on lands bordering on the sea. The greatest groups are in Java, Iceland, the Hawaiian islands and on the shores of the Mediteranean.

Taking the world over, the mass of matter erupted by volcanic action is truly enormous. Immense quantities of steam issue forth in volcanic eruptions, and it is thought to be the chief agent of eruption.

How the heat is generated or occasioned that causes the production of the steam and melted matter, is a source of much dispute.

One of the safest opinions is that the heat is in a great measure generated by chemical action, water meeting and combining with the metaloids; and the friction of mechanical crushing caused by the enormous pressure of the crust.

Earthquakes.—Earthquakes are agents in shaping the earth's crust. The earthquake may be but a slight tremor or a most violent movement of the crust, destroying whole cities and throwing great massive bodies high in the air. For the whole earth they are quite frequent and may be said to average one in every hour for the year around. The movement may be straight up and down, from side to side, obliquely or twisting. The movement begins at a centre called the epicentrum, and thence spreads in all directions just like waves when a stone is thrown into a pool of water.

The cause of earthquakes is still more or less obscure. Some of them are caused by great volcanic explosions, but the mighty ones are associated to the settling down of the earth's crust.

There are mighty forces operating in the earth's interior, elevating the earth's crust in places and depressing it in others, and crushing the different portions together where the crust gives way at weak points. These crushings often break the crust, forming great fissures and producing violent motions of the surface.

These quakes frequently occur in the beds of oceans as indicated by the mighty tidal waves, 50 to 60 feet high, that often strike the shores and produce great destruction.

It is now known that there are forces elevating and depressing the earth's crust, acting slowly and gradually, and perceptible through their effects only after the closest observation. These are the real forces that have caused all the great inequalities of the earth's surface. Whenever the crust yields suddenly under the resultant of these forces, we have the phenomena of earthquakes.

But those slow but mighty forces have been at work for vast epochs. Normally these forces are so slow, that the crust yields gradually, and there is no sudden crash.

During a vast period of time, there has been a gradual elevating of the South American Continent out of the ocean. Old beach marks are now found as high as 1300 feet above the sea-level and extending easterly along the coast line for 1100 miles, and westerly 2,000 miles. And dead corals sticking to the rocks 3,000 feet above water mark, have been found on the same coast. There are also the clearest evidences of up and down movements along the Italian coasts of the Mediterranean. Cliffs on the coast, and the columns of the bridge of Caligula are bored, several feet above the present sea-level, with holes made by the lithodomi, a species of marine-boring shell, and the temple of the Nymphs is now under water.

Scandinavia has been for long ages rising bodily out of the sea, at the average rate of from 2 to 3 feet per century. Old beach marks as high as 600 feet above sea-level are evidences of this.

Greenland is slowly but gradually subsiding. This fact is recognized by the Esquimaux, who never build near the sea-level.

In river deltas and other places where vast loads of sediment have accumulated, there are evidences of subsidence, as if the crust was there weighed down with its mighty load. And, as already stated, in the great bed of the Pacific over an area of 10,000,000 square miles, there has been an average subsidence of 10,000 feet as shown by the testimony of coral formation.

It would seem then that the principal inequalities of our planet's surface have been caused by a slow cooling and unequal contracting of the crust.

Though the effects of these two kinds of agencies, elevating and leveling, are almost insignificant at the present time, yet when continued through immense ages, their result would be enormous and amply sufficient to account for the earth's present shape.

We have thus far considered the combination of forces, that, after continuous ages, molded the earth into its present form. The next step is to learn as accurately as possible the present structure of our globe, and the length of time required for its formation.

Chapter XII.

RESULTS OF GEOLOGY.

(*Present Structure.*)

The figure of the earth is generally regarded as an ellipsoid of revolution or an oblate spheroid, having an ellipticity of $\frac{1}{288.48}$, the polar being 13 miles shorter than the equatorial radius. Strictly speaking, however, the earth has no purely geometrical figure, the nearest approach to its exact form geometrically, being an ellipsoid of three unequal axes. This general form is exactly that which a molten fluid mass of matter of the earth's size, and rotating on an axis with the earth's axial rapidity, would inevitably assume. This general form of the earth is taken at the sea-level, the continents rising on an average 1200 or 1300 feet above and the sea-bottoms sinking 15,000 or 16,000 feet below this level.

The space occupied by the oceans being three times as extensive as that by the land, if the earth's surface could be perfectly leveled off, water would cover the globe entirely around to a depth of about two miles.

The mean density of the earth is 5.55 times that of water; the density of the crust being 2.5 times, and of the central parts probably 16 times that of water.

What is known as the crust of the earth, is estimated at about an average of 20 miles in thickness. Our knowledge of this thickness of crust has been collected from deep borings, cañons, volcanic ejections and faults, or crust foldings followed by erosion. Our chief geological knowledge has come from this last source, as strata have been eaten away by erosion to depths of more than ten miles.

ROCKS.—In geology, the term "rock" signifies any substance, hard or soft, constituting a portion of the earth's crust. In geology, the distinction of stony hardness or plastic softness is of no value. Rocks are divided into the stratified and unstratified.

Stratified rocks are of aqueous origin and have been generally formed by sedimentary consolidation.

Unstratified rocks are those of igneous origin, are more or less fused, and of a crystalline structure.

STRATIFIED ROCKS.—In examining great beds of sandstone and limestone, the stones are found to lie in regular layers. In great plains or level regions, the layers are level or horizontal and in mountainous regions they are inclined and often vertical.

In fact any great mass of stratified rock is found to be divided up by parallel planes into beds of different thickness. The thicker beds are called strata. The strata are divided by planes into thinner subdivisions called layers, and these again into very thin divisions or lines of sorted materials called laminæ.

These beds are all the product of water-sorting, and the structure is called stratification. Nine-tenths of the land-surface of the earth is covered by stratified rocks and where stratification is wanting, it has been removed by erosion or covered by igneous rocks.

The extreme thickness of stratification is from ten to twenty miles, and as stratification virtually extends over the whole earth, so there is no portion of it which has not been at some time covered by the sea.

Stratified rocks are for the most part consolidated sedimentary deposits.

The laminæ of sandstones and shales, when closely examined, show the water-sorting of materials. The fossils of the shells and skeletons of animals are found in the stratified rocks. Ripple-marks, rain-prints, foot-prints of animals are found in the stony matter of stratified rocks. In these stratified rocks, in fact, are found every mark, character and peculiarity which have been observed in recent sedimentary deposits.

Stratified rocks, then, wherever found, in the interior of continents or high up on mountain sides, are all sedimentary deposits in water. There is thus an everlasting cycle of processes going on. Rocks are disintegrated and decomposed into soils, soils are removed and deposited as sediments, sediments are hardened into rocks, these rocks are raised up into surfaces by mighty forces and again rotted down into soils.

Stratified rocks have been formed slowly and gradually, and sometimes indeed, with extreme slowness and by the regular and continual operation of causes similar to those now accumulating sediments. The laminæ of some strata are as thin as fine paper, and each individual one represents more or less considerable lapse of time, such as the flood and low water of rivers or the ebb and flow of tides.

Some limestone strata are composed entirely of the remains of successive generations of microscopic shells, every inch thickness of which represents a long period of time, and yet these deposits are often thousands of feet thick. Sandy or coarser materials are, however, more rapidly deposited than limestone, still as a rough rule, thickness is a measure of time.

Owing to the manner in which stratified rocks have been formed, namely from sedimentary deposits in water, they must have been originally horizontal at the bottom of water, and when we find them in other positions and at other levels, we naturally conclude that subsequent change has caused it.

Strata, however, must not be likened to perfectly continuous and even sheets of paper, but rather to irregular cakes, thick in the middle and thinning out towards the margins. Strata continually interlap with other strata. Sandstones and other coarse deposits are less continuous and extensive than clays and other finer materials.

At first the strata were all horizontal and at the bottoms of rivers, lakes or seas; now, however, we find them in the interior of continents and far above the sea-level, sometimes still horizontal, but generally more or less inclined; sometimes, indeed, in mountain regions, folded, crushed, broken and contorted in every possible manner. Commonly, large portions of the upper parts of the strata that have been crushed and dislocated, have been carried away by erosion, leaving the edges exposed. The exposed edges of the strata are called the outcrop.

It has been already stated that land-surfaces are sinking beneath the ocean, and ocean-beds are rising up to become land-surfaces. This process has been going on throughout all geological times. It has also been seen that the rocky strata of land-surfaces are often crumpled and tilted and so eroded that their edges are exposed. If at any time an eroded land-surface should sink beneath the sea, and should sediments be deposited upon the eroded edges and fill the erosion-hollows of a strata, and the whole be again by some agency raised above the sea, we would have what is known as unconformity in the resulting formation. Commonly, but not necessarily, there would be a want of parallelism between the two series of the strata.

A series of strata are said to be conformable, when they are parallel and appear to be formed continuously under similar conditions. Two series of strata are unconformable when they are discontinuous and separated by an old land-surface or erosion surface, and consequently formed at different times and under different conditions.

The history of the earth's surface is read in its stratifications. A group of conformable strata ordinarily form a geological formation, and a line of unconformity usually divides two different geological formations. While a place is land-surface, and is being eroded, there can be no strata formed there at that time, and it is clear that a line of unconformity indicates a period of which there is no record at that place, although the record may be found in some other place.

Unconformity then represents a gap in the geological record of strata.

In classifying stratified rocks, geologists have endeavored with the greatest care to arrange the strata, from the highest to the lowest, in the order in which they were formed. From the very nature and manner of sedimentary deposits, it is clear that, unless they have been greatly disturbed, their relative position indicates their relative age, the uppermost strata or line of sediment being invariably the youngest. It is, then, an easy problem for the geologist to make out the relative ages of the different strata, composing a natural section of an exposed sea-cliff or railroad cut, either horizontal or regularly inclined.

But when the rocks by some agency have been crumpled, folded, broken, pushed beyond the vertical, and a part worn away by erosion, to show their real relations, under such circumstances is a most difficult affair.

Another element to enhance the difficulty of the problem, is that all the strata are not represented in any one place, but ordinarily only a small fraction.

In endeavoring to arrange all the strata of the earth's surface according to the age of deposition, the geologist has then no easy task, as he finds in different places only small fragments of the whole.

The order of superposition must, when it can be applied, take precedence of all other methods, still this method is greatly aided by a careful comparison of the rocks in different places with each other. There are two methods of comparison, by the character of the rock and the character of the fossils. The method of comparison by rock-character is only of value in contiguous places. In widely separated places, it is of no value, as sandstone, clay, limestone and chalk of the same grain, color and composition have been found in all epochs.

We cannot conclude that rocks are of the same age, because they are similar in appearance. The most valuable and safest method of determining the age of rocks, is by comparison of the fossils. If these are similar in species, it is generally concluded, making proper allowances, that the rocks in which they are found belong to the same age.

Geologists all over the world, working in harmony, have succeeded in making a fairly complete chronology of the strata of the earth's crust. Breaks in one place, are filled by strata in another. The more perfectly the earth's surface is studied, the completer will this chronology become. And hence, new discoveries will bring new improvements.

The following is a generalized schedule of the divisions of the rocky strata of our planet's crust: Laurentian, Huronian, Primordial, Canadian, Trenton, Niagara, Salina, Helderberg, Oriskany, Corniferous, Hamilton, Chemung, Catskill, Subcarboniferous, Carboniferous, Permian, Triassic, Jurassic, Cretaceous, Tertiary, Quaternay, Human.

Igneous Rocks.—Igneous rocks are derived by cooling and crystallization from fused material. All that is necessary to say about them here, is that they have neither stratification nor fossils.

An intermediate series of rocks between the stratified and igneous, are the Metamorphic, but as they are devoid of fossils, they too may be passed over without consideration here.

Sedimentation is the aggregate sum of sedimentary deposits and denudation, its correlative term, that of erosion. Rain and rivers are the chief agents of erosion. Waves and tides produce about the one-fifth of the erosive effect of rain and rivers. Snow and glaciers are erosive agents, but they are classed with rain and rivers.

In order to compute roughly the time required to give the earth's surface its present shape, it will be necessary to compute the whole amount of denudation, that has taken place in geological time, and the rate of rain and river erosion.

The amount of denudation is determined by geologists in a variety of ways. One method is from the examination of faults. Fissures are great fractures of the earth's strata by crust-movements. As has been already noticed, portions of the earth's crust are frequently subjected to powerful horizontal pressure, by which it is mashed together. These bendings of the crust produce enormous fractures or fissures.

The walls of the great fissures nearly always slip one on the other, up or down. Such a displacement of the crust on the two sides of a fissure, is called a fault. All the surface indications of the slip, are often entirely obliterated by the work of erosion. In some faults the result of erosion is very great.

Another, and a still better way of measuring erosion, is by the restoration of folded strata.

The amount of general erosion is also measured by the amount of its correlative, sedimentation. The stratified rocks of the earth are the debris of general erosions. The average thickness of strata of the earth's surface cannot certainly be less than 2,000 feet, and as the ocean area is three times that of the land, this would necessitate at least 6,000 feet erosion of all land surfaces. General erosion has then, at the least computation, removed 6,000 feet over all land surfaces. But the rate of rain and river erosion is on an average one foot in 5,000 years. It would thus require 30,000,000 years to accomplish the work of erosion, that we actually find to have been done.

What the geologist asks for is time in bringing the earth to its present shape. But this can be granted without falsifying the Bible record.

There are two interpretations of Genesis that admit the claims of Geologists, of a great age for the earth. One is by giving to the words: "In the beginning" (God created the heavens and the earth) an indefinite length of time.

Matter was all created in this Beginning before the first Mosaic day, and afterwards fashioned into its different shapes.

Some of the greatest commentators of the Bible are in favor of this interpretation of an interval of indefinite duration between the creation of the world and the first Mosaic day, as for instance, St. Basil, St. Chrysostom, St. Ambrose, Peter Lombard, Hugh of St. Victor, St. Thomas and Perrerius.

Another interpretation making the Mosaic days vast periods of time, would be in most perfect accord with the claims of geology.

Some very great commentators favor this interpretation. St. Augustine, Molina, Patavius, Venerable Bede, St. Eucherius and St. Hildegarde contend that the days in Genesis must not be regarded as ordinary days, but are used for the word time.

Geology is therefore in accord with two legitimate Biblical interpretations, in regard to the question of time.

Chapter XIII.

RESULTS OF GEOLOGY. (Con.)

(*Fossils.*)

There is nothing in the whole record of Moses so determinedly combatted by a certain class of scientists, as his order of creation. These scientists use as their chief weapon, the testimony of fossils. It is thus of vital importance to explain as thoroughly as possible the character of fossils, and determine the reliability of their testimony.

Fossil, a derivative of the Latin, *fossilis*, and this from *fodere*, *to dig*, signifies a substance dug from the earth, giving any evidence of the former existence of a living thing. Fossils reveal the nature of the former inhabitants of our planet.

Stratified rocks are the consolidated sediments of former rivers, lakes and seas. In past ages as at present, the mud at the bottoms of seas and rivers contained shells, branches and leaves of trees, and remains of animals carried down by currents and buried there. These remains have in different ways been preserved to the present time, and are now fossils.

Fossils are an invariable characteristic of stratified rocks. In rare instances, fossils are the very organic matter of the soft parts of animals, wonderfully preserved. In the frozen soil of Siberia, the bodies of extinct rhinoceroses and elephants have been exhumed by currents, so perfectly preserved, that wolves fed on the flesh.

In peat-bogs, too, which are great antiseptics, are found well preserved skeletons of extinct animals, the organic substance of the bones being still retained. In other cases, in peat-bogs, the flesh is preserved, but has been changed into the fatty substance known as adipocere.

As a rule, however, only the form and structure of the shells and skeletons of animals are preserved, and sometimes the form alone has survived.

The organic structure is frequently preserved by the process of petrifaction. Petrified wood is the best illustration of this process. Drift-wood is found completely changed into stone in many strata, and particularly in lava beds. In these instances, not only is the general structure of the bark, wood and pith retained, but the minutest tissues and markings are most perfectly preserved in the stony matter that has replaced the wood. In petrifaction, the substance of the wood is replaced by stony matter, the wood, however, is not turned to stone. The best and most common petrifiers are carbonate of lime and silica. As the particles of the woody substance pass away by decay, particles of the mineral solution are deposited in their place, thus reproducing perfectly in stone the woody structure.

Similarly to wood, the structure of bones, corals and shells is preserved, although the original matter has entirely disappeared.

Often the structure is lost, and only a cast or mold of the external form is preserved in stone. This is found to have been preserved in different ways. Thus, in the case of shells, the living or recently dead shell was buried in mud, and subsequently the organism was completely dissolved and removed, leaving only the hollow case or mold where it lay.

In other instances the mold has been afterwards filled and a cast made by the deposit of mineral solution. Again the dead, empty shell was buried in, and filled with mud, and subsequently the shell was removed by solution, leaving an empty space equal to the thickness of the shell. Now this hollow space corresponding to the thickness of the shell, was afterward filled by the deposit of soluble stony matter.

Sometimes, even, we find only the mold of a small portion of the organism, such as the impressions of leaves and the foot-prints of animals left on soft mud, which afterward hardened.

All fossil traces are of value because they are very characteristic parts of plants and animals.

The species of the fossils we may find in the rocky strata, will depend on the country and on the kind and age of the rock.

A few words here, by way of prelude to fossil history, about how species of plants and animals now living on the earth, are distributed and the laws governing the distribution of living species.

A tourist visiting different countries readily recognizes the great difference in the native plants and animals. He easily perceives that the species of the various countries are almost always entirely different. As a general fact it may be said that each country has its own native species, differing more or less markedly from those of other countries.

The whole group of plants inhabiting

one place or country is called its flora, and of animals, its fauna. In regard to fauna and flora, nature has set up her natural boundaries or limitations. The chief natural boundaries are geographical and climatic.

A natural fauna or flora is a natural group of animals or plants in one place, differing from other groups in other places and separated from them by natural boundaries of a climatic or geographical character.

Temperature is the most important of the climatic conditions, limiting fauna and flora. Plants being fixed to the soil are more strictly limited in regard to the distribution of species than animals.

Elevation above the earth's surface and latitude are the chief causes of the change of temperature conditions. If, in the first place, we take the case of plants and select a high mountain near the seashore in a tropical region we will find there all conditions of temperature. Beginning at the base of the mountain and ascending we find a region of palms; of hard-wood; of pines; a treeless region; and a plantless region. Similarly in regard to latitude, in going from the equator to the poles, we find a region of palms in the tropics; a region of hard-wood in the temperate zones; a region of pines in the arctics; a circumpolar treeless region of shrubs and herbs; and a plantless region near the icy poles.

The spread or extension of species is limited by natural boundaries or barriers. All organic forms will spread in all directions, as far as physical conditions and the struggle for life will allow. The range of a species is the area over which it has spread. The hardier a species is, the greater may be its range, but the range of a species is more limited than that of its genus, and the range of a family, greater than that of its genera, and of an order than a family.

The several temperature regions graduate into each other insensibly. Species reach their highest development in vigor and number about the middle of their range, gradually falling away on the borders. They come in and go out gradually, the ranges overlapping on their borders. "But in specific character there is no such gradual passage of one species into another, no evidence of transmutation of one species into another, nor of derivation of one species from another. From this point of view, species seem to come in at once in full perfection, remain substantially unchanged throughout their ranges, and pass out at once on the other border, other species taking their place as if by substitution, not transmutation. It is as if each species originated, no matter how, somewhere in the region where we find them, and then spread in all directions as far as physical conditions and struggle with other species would allow." (Le Conte, page 110.)

Certainly the study of species as we now find them, could not prove the theory of their origin by derivation or transmutation. Where no barriers exist, temperature regions shade into each other. Species will be found distinct and without any overlapping of each other where there are great natural barriers, such as mountain chains, seas and deserts.

It is also found that although on lofty mountains in the tropics, the same range of temperature exists as in high latitudes, still the species are always entirely different because the torrid zone acts as an impassable barrier and prevents migration. Thus species invariably originate each in its own place and has been prevented from overlapping or mingling by the presence of impassable barriers.

Animal species, like plants, exist in temperature zones, but cannot be so simply arranged as that great classes correspond to great zones. Zonal arrangements of families cannot be as easily made with animals as plants; but if we confine ourselves to species or genera in general, animals are subject to the same laws of distribution as plants. Thus: All animal species are limited in range; the range of species is less extensive than that of genera, and of genera than of families, and of families than orders; Contiguous ranges graduate into each other by overlapping on the borders; Each species reaches its greatest vigor and abundance in the middle region and dies out on the borders. In specific character they remain essentially the same throughout their range and do not transmute or change into other species on the borders. Physical conditions may limit their range, but do not change them into other species, though varieties may be formed in this way. With animals as with plants, species originate in the places we find them and spread in all directions as far as physical conditions and the struggle with other species will allow.

The faunas and floras of the different continents of the globe are substantially different, owing to the existence of the great ocean barriers interposed between them. If there were no such impassable barriers, the faunas and floras of the earth would be arranged in temperature zones from the equator to the poles, containing the same species all around.

The various species seem to have originated on the continents where they are found and have been prevented by impassable barriers from overlapping or intermingling.

There are a few exceptions to this. Hardy species that migrate widely, sometimes pass over from continent to continent; introduced species that have grown wild; and Alpine species.

The whole earth has been inhabited at different times by entirely different species. All the animals and plants inhabiting the earth at one time, are called the fauna and flora of that geological time. We have thus a fauna and flora of the Devonian, Jurassic and Tertiary times.

It is found as a general principle that the change from one geological fauna to another is gradual when the strata are conformable, but on the contrary that a line of unconformity usually abruptly separates two faunas.

A series of conformable strata, in which the fossil species are either the same or change very gradually, are called a formation, and the time during which such a formation has been laid down is known as a geological period.

Unconformity of the strata and trenchant change in the species are the great tests determining the limits of a geological formation and a geological period. The latter test is regarded by geologists as the more valuable.

It is considered by geologists as an established fact that in the successive changes of geological species as manifested by their fossils from the earliest times down to the present there is a steady approach to living forms both in families, genera and species in the order named.

Not until the Tertiary period do species begin to be identical with the living species, and thence onward we have an increasing percentage, identical with the living.

Rocks, all the world over, are known to belong to the same time by the general similarity of their fossil species. There is found but little difficulty in applying this rule up to the Tertiary period, when the geographical diversity begins to be so great as to materially interfere with the general similarity.

But beginning with the Tertiary another principle is put in use, the percentage of the fossil species still living in the immediate vicinity. The same age is indicated by similar percentage, less age by greater percentage and greater age by less percentage.

The geologist endeavors to form as perfect a chronology as he possibly can of the order of formation of the earth's crust by classifying the strata or arranging them from lowest to highest, in the order in which they were formed or laid down; and then to separate them into groups and sub-groups for convenient treatment.

From the manner in which sediments are formed it is very evident, that, if they have not been greatly disturbed, their relative ages are indicated by their relative position; the uppermost being always the youngest. It is, then, an easy matter to make out the relative ages of a natural section of strata where we find them regularly inclined or horizontal and undisturbed.

But when the rocks are discovered to be folded, crumpled, broken, slipped and partially eaten away by erosion, to make an ideal section showing their real relation to one another in the matter of age is a difficult problem; and the difficulty is enhanced by the fact that all the strata are not represented in one place. Only a fraction, and indeed, a small fraction of the whole is usually found in one place.

The order of superposition takes precedence of all other methods in determining the ages of the rocks where it can be applied, still it is well to supplement it by a careful comparison of the rocks in different localities with each other. There are two means of comparison, by the character of the rock and the character of the fossils. The method of comparison by rock-character is not of much assistance except in contiguous localities. Sandstones, clays, limestones, coal and even chalk belong to nearly all times, and are forming now.

Groups of similar rocks and in contiguous localities are probably of the same age. But for rocks of similar grain, composition and color, in different continents, we can not use this method.

But the most valuable and general means of determining the age of rocks in all parts of the world is by the comparison of their fossils. Whenever we find a general similarity of species, we conclude that the rocks belong to the same age. Allowances must, however, be made for difference of conditions of deposit, whether shore, deep-sea, fresh-water or marine deposit.

Geographical diversity must be also considered. In the fossils of rocks in different continents, absolute identity should not be sought, but only general similarity.

The nature of the fossils, then, determine the age of the rocks. Fossils of different species are found in rocks of different ages. As a universal and fixed rule, when we know the fossil species, we know the ages of the rocks.

The testimony of the fossils has been regarded as the strongest weapon in the arsenal of the evolutionists to prove their pet theory. However, when truly and impartially given, the evidence of fossils is really strongly against the transmutation of one species into another; is in fact an absolute contradiction of it and demonstrates a separate creation. This will be seen better under the headings of Biology and Anthropology. Still the proper place for a description of fossils is here under the head of Geology.

Chapter XIV.

RESULTS OF GEOLOGY. (Con.)

(Testimony of the Fossils.)

The fossil history of the earth is divided into seven ages, each characterized by the dominance of some particular class of animals or plants. Each fossil age corresponds to a separate system of rocks. We have, for instance, an age of Acrogen plants, an age of reptiles, an age of mammals, in which Acrogens, reptiles and mammals are the dominant types.

In geology it is found that each dominant class culminates and declines, it does not entirely perish, but only becomes subordinated to the incoming and higher dominant class.

The following are the fossil ages and corresponding rock systems: Archæan age, corresponding to the Eozoic (dawn of animal life) rocks (Laurentian and Huronian); Age of Mollusks, or age of Invertebrates, corresponding to the Silurian rocks; the Age of Fishes, corresponding to the Devonian; the Age of Acrogen Plants, corresponding to the Carboniferous; the Age of Reptiles, corresponding to the secondary rocks; the Age of Mammals, corresponding to the Tertiary and Quaternary rocks; and the Age of Man, corresponding to the present sedimentary deposits.

The Archæan (ancient, beginning) system of rocks is the most distinct of all the others, there being absolutely everywhere an unconformity between them and every other system. They are the oldest known rocks. They are, however, stratified rocks and consequently the hardened sediments of other and more primitive rocks of which the geologist absolutely knows nothing.

These Archæan rocks are always strikingly metamorphic and highly crumpled. These rocks are very extensive and contain the greatest beds of iron-ore of any strata on the globe. They are of an immense thickness and likely are equal in depth to all the subsequent strata together.

Some geologists think that they have

found evidences of at least the dawn of life in the time of the Archæans. They claim that the vast deposits of iron-ore found in these rocks, as also the presence of graphite and limestone, give some indications of the previous existence of life. They say that the existence of the lowest forms of vegetable life in these strata is almost certain, and of the lowest forms of animal life (Protoza) probable. However, the best geological authority maintains that no life flourished in the time of these rocks, and applies the name Azoic (no animal life) or simply Archæan, to designate the strata.

Between the Archæan and Silurian rocks, also called the Palæozoic (old life), the greatest and most universal break of the whole series of the globe's stratifications occurs. These two series of rocks are nowhere continuous; they are everywhere completely unconformable.

The period between the Archæan and Palæozoic rocks is regarded by geologists as a lost interval of time. In Archæan times there were certainly no fauna or flora. The Palæozoic is regarded as the most distinct era in the earth's history in regard to life on its surface. With the Palæozoic era begins a distinct and well defined fauna and flora.

The Palæozoic rocks are much less thick, crumpled and metamorphic than the Archæan.

The Palæozoic rocks are divided into the Silurian, the age of Mollusks; the Devonian, the age of Fishes; and the Carboniferous, the age of Acrogen plants.

The Silurian rocks derive their name from Silures, the Roman name for the ancient Welsh of these rocks, as they were first studied in Wales. The Silurians compose the Primordial, Canada, Trenton, Niagara, Salina, Helderberg and Oriskany.

The only plants found in these rocks are sea-weeds. The animals are the lowest in the scale of life. For instance, of the Echinoderms, only the most imperfect forms are found, the Crinoids. Of the Mollusks we find the Brachiopoda. Of the Articulata we find Trilobites, the lowest forms of the Crustaceans. These Trilobites show an extraordinary want of development and completeness.

In the Palæozoic era reigned Fishes and Acrogen Plants. Fishes existed in great abundance. In the early portion of the Palæozoic era, the sea is supposed to have covered the whole surface of the globe. The fishes of this era, however, were not at all like the common fishes of the present time.

There were no high mountains nor deep

depressions, and consequently no mighty barriers to the mingling of the fishes of the universal ocean. The animals of that early era without exception were all aquatic, and they were singularly alike all the world over. These Palæozoic fishes reached their greatest development in the Devonian system of rocks.

The Carboniferous age is noted for the extraordinary abundance and luxuriance of its vegetables and plants. It is the age of the Acrogens.

This age is subdivided into the Sub-Carboniferous; Carboniferous; and Permian periods. The Carboniferous age is itself but one of the three ages of the Palæozoic era. The Palæozoic is but one of the five great eras including the present. The great eras are the Eozoic (dawn of animal life); Palæozoic (old life); Mesozoic (middle life); Cenozoic (recent life); and Psychozoic (rational life).

The Carboniferous period is not more than one-twentieth to one-thirtieth of the earth's geological history, and yet during its continuance were preserved nine-tenths of all the coal of the globe. Coal is the fossil remains of decayed plants and vegetables. The earth must have absolutely teemed with plants and vegetables during this period, and it is well designated as the reign of acrogen plants.

In early geological times and particularly during the Carboniferous age, more moisture and carbonic acid gas, and less oxygen existed in the atmosphere than at present. While this condition of things would make a paradise for plants and vegetables, especially of the lower orders, it would be entirely unsuitable for air-breathing animals. The air was greatly purified during the Carboniferous age by the withdrawal of Carbonic acid gas, by the immense growth of vegetables, for plants absorb or breathe this gas, and much of the superabundant moisture was absorbed by the rising of the continents out of the sea. Thus moisture and carbonic acid gas were removed and pure oxygen restored to the atmosphere, which was thus gradually prepared to support the life of air-breathing animals.

The Mesozoic era follows the Palæozoic, but unlike the latter, that consisted of three ages, the former embraces only one, the Age of Reptiles. Never in all geological ages were reptiles so abundant, of such vast proportions and such fine organism as during this era. Among animals, reptiles were so markedly predominant that the Mesozoic era is designated the Age of Reptiles.

This era is divided into two periods or

rock systems, the Jura-Trias and the Cretaceous (chalk). During this era reptiles were rulers on the land, in the air and in the sea.

The Ichthyosaurus was a sea-serpent, 40 feet long, eyes fifteen inches across and jaws set with hundreds of conical teeth. In this era flourished the Dinosaurs, colossal land reptiles, and the largest animals that ever walked the globe. The mighty Iguanodon and Megalosaurus were Dinosaurs.

The marvelous Pterosaurs were winged reptiles.

Next follows the Cenozoic (recent life) era and the age of Mammals. In this era throughout the earth Mammals are the dominant class of animals. The Mammalian age and Cenozoic era are divided into the Tertiary and Quaternary periods. The suddenness of the appearance of mammals in this era is very remarkable. True mammals of the highest order appear in vast numbers and great diversity in this era, without warning and without progenitors. Nowhere else in the history of the earth's fauna is the work of a special creation and a special providence more apparent.

During Quaternary times, mammals attained their greatest development. This was the period of the Mammoth and the Mastodon, either more than twice the size of the largest living elephant. It was, too, the period of the South American Megatherium and Mylodon, and the Australian Diprotodon.

The Quaternary period has been divided into the Glacial, Champlain and Terrace epochs. The terrible cold of the Glacial epoch is supposed to have been occasioned by the elevation of the northern hemisphere and to slow changes in the form and position of the earth's orbit (Croll).

Geology teaches that the earth was specially prepared for the Psychozoic era and Age of Man by the extinction of the great ruling mammals of the Cenozoic era and a diminution of noxious animals and plants. The mammoth, mastodon, cave-bear and saber-toothed tiger disappeared before the advent of man.

Geology clearly points out that the succession of created beings on the earth's surface is the realization of an infinitely wise plan. Consequently there must be a necessary relation between the races of animals and the epochs at which they appear.

There has been a manifest progress in the succession of beings upon the globe. This progress consists in an increasing similarity to living animals and particularly in their increasing resemblance to Man. But this connection is not in consequence of a direct lineage between the faunas of different ages. There is nothing like parental descent connecting them. The Fishes of the Palæozoic era are in no respect the ancestors of the Reptiles of the Mesozoic era, nor does Man descend from the Mammals which preceded him in the Cenozoic era. The link by which they are connected is of a higher and immaterial nature; and their connection is to be sought in the view of the Creator himself, whose aim, in forming the earth, in allowing it to undergo the successive changes which Geology has pointed out, and in creating successively all the different types of animals which have passed away, was to introduce Man upon the surface of our globe.

Man is the end toward which all the animal creation has tended, from the first appearance of the first Palæozoic Fishes. In the beginning His plan was formed, and from it He has never swerved in any particular. The same Being who, in view of man's moral wants, provided and declared, thousands of years in advance, that "the seed of the woman shall bruise the serpent's head," laid up also for him in the bowels of the earth those vast stores of granite, marble, coal, salt, and the various metals, the product of its several revolutions; and thus was an inexhaustible provision made for his necessities, and for the development of his genius, ages in anticipation of his appearance.

When we consider the creations of the geological eras, the Palæozoic, Mesozoic and Cenozoic, and compare them with those of the Days of Moses, we will find the Mosaic and geological records to have a wonderful coincidence.

The Palæozoic era rejoiced particularly in the extraordinary luxuriance of its vegetation, and this corresponds to the Third Day of Genesis when God said: "Let the earth bring forth the green herb, and such as may seed, and the fruit tree yielding fruit after its kind, which may have seed in itself upon the earth. And it was so done. And the earth brought forth the green herb, and such as yieldeth seed according to its kind, and the tree that beareth fruit, having seed each one according to its kind."

The animals of the Mesozoic era and age of Reptiles correspond to the creations of the Fifth Day of Moses: "God also said: Let the waters bring forth the creeping creatures having life, and the fowl that may fly over the earth under the firmament of Heaven. And God created the great whales, and every living and moving creature which the waters brought forth, according to their kinds, and every winged fowl according to its kind."

In the Mesozoic era and the Fifth Day reigned on the earth huge creeping things, lizards and crocodiles; and the deep swarmed with its wonderful whales, not of the mammalian but reptilian class. This era was a time of whale-like reptiles of the sea, monster creeping reptiles of the land, and reptilian birds of gigantic stature.

The Cenozoic era and the Sixth Mosaic Day had its grand mammalian creatures. "God said: Let the earth bring forth the living creature in its kind, cattle and creeping things, and beasts of the earth, according to their kinds. And it was done. And God made the beasts of the earth according to their kinds, and cattle and everything that creepeth on the earth after its kind."

Towards the end of the Sixth Day which corresponds to the Psychozoic era, God created man himself. It must be admitted that the chronology of the geologists is a very imperfect one indeed, very loose and broken. But its links, wherever they can be traced, marvelously agree with the Mosaic record.

Three of the Mosaic Days belong to Astronomy and three to Geology. The geological records that have hitherto been brought to light, represent but the merest fragment of the earth's past history. Each new year is adding to the store of facts already gathered. So that a geological hypothesis may be entirely consistent with the knowledge we possess to-day, and yet may be found altogether inconsistent with the knowledge we shall possess in a few years.

An objection is raised against the harmony of the Mosaic Days and the records of Geology, particularly concerning the history of early organic life on our globe. The Third Day of Moses corresponds with the Carboniferous period and yet there is evidence of the existence of both plant and animal life long anterior to this, indeed as far back as the Laurentian Rocks themselves.

Again, Moses represents the Fishes as having been created on the Fifth Day, corresponding to the Mesozoic era. On the other hand the geological record assigns to the Devonian period, away back in the Palæozoic era, the reign of Fishes.

But there is in reality no contradiction between the records. "The Sacred Writer tells us, no doubt, that on the Third Day God created plants and trees: but he does not say, either expressly or otherwise, that previous to the Third Day the Earth was devoid of vegetation. Again, we read that reptiles, fish, and birds were created on the

Fifth Day. But there is nothing in the language of the Inspired narrative from which it can be inferred that these several classes of animal life may not have been represented before that time, by many and various species: though probably, it was only on the Fifth Day that they were developed in such vast numbers, and assumed such gigantic proportions, as to become the most conspicuous objects of creation.

The first chapter of Genesis is but a brief summary of an inconceivably vast series of events. It is nothing more than a rapid sketch, exhibiting, as it were, to the eye the prominent features in the history of Creation. Moreover, we should remember that it was written with a specific end in view. The purpose of the Sacred Writer was plainly to impress upon the Hebrew people, naturally prone to idolatry, the existence of One Supreme Being, who has made all things. Hence we should naturally expect that, amid the boundless variety of God's works, he would make choice of those that were most calculated to strike the mind with wonder and awe, and to bring home to a rude and uncultivated race of men the Almighty Power and Supreme Dominion of the Great Creator. Now the Zoöphytes, and Graptolites and Trilobites, of the Devonian and Silurian periods, however curious and interesting they may be to men of science, would have had but little significance for the Jewish people. Let us suppose that these more humble forms of animal life had, in fact, existed during the First and Second Days of the Mosaic narrative, and where is the wonder that the Inspired Historian, under the guidance of the Holy Spirit, should pass them by in silence, and choose rather to commemorate the more striking and impressive facts, that, at the bidding of God, light shone forth from the midst of darkness, and the blue firmament of Heaven was expanded above the waste of waters?

We say, then, that events which are simply left unrecorded by the Sacred Writer are not, on that account, untrue, (St. Augustine, Confes. Lib. xii., cap. xxii): that he describes to us, not all the works of Creation, which would have been an endless task, but only the more conspicuous objects in each successive stage; and that he sketches them, most probably, as they would have appeared to the eye of a human observer, if a human observer at the time had existed on the Earth. If this view be admitted, then it is not inconsistent with the Scripture narrative to suppose that plants may have existed before the Third Day, and fish before the Fifth.

"Each Day in its turn would have been

rendered conspicuous to an observing spectator by those events which are recorded by Moses. But each Day, too, would have witnessed many other events, unnoticed by Moses, of which the memorials have been preserved, even to our time, in the Crust of the Earth." (Molloy, page 352).

Now it may well be asked where could Moses have obtained his marvelous knowledge regarding the order of creation? Not certainly from natural sources, no fossils had been then classified, no rock systems arranged, geology was not known. Must it not be confessed that his knowledge was the work solely of Divine inspiration?

Chapter XV.

RESULTS OF BIOLOGY.

(Principles.)

Among the bitterest and most persistent adversaries of the Mosaic record are a certain class of agnostic biologists. They maintain that living beings have sprung from dead matter through spontaneous generation, and from the very lowest monera came man after a long series of transmutations. For it is the final purpose and object of Darwinism or Specific Evolution to demonstrate the transmutation of brute animals into man by showing that one species can change into another.

It is thus of paramount importance to set forth the vital principles of Biology, weigh the grounds for spontaneous generation and consider the doctrine of the descent of species. Biology (Gr. βίος, life, and λόγος, discourse) is the science that treats of living beings and life in general.

Life is a most difficult thing to define within proper limits, and indeed, its perfect definition seems to be an impossibility. One of its best definitions is that of G. H. Lewes: "Life is a series of definite and successive changes, both of structure and composition, which take place within an individual without destroying its identity."

The animal and vegetable kingdoms embrace all living beings on our planet and hence Biology includes the sciences of Zoölogy and Botany.

All objects in nature are either living or dead. The following leading characteristics may be said to distinguish living from dead bodies: 1. Every living body has the power of assimilation or growth by which it takes into its interior certain materials foreign to those composing its own substance, and of converting these into the materials of which its body is built up.

When, on the other hand, dead bodies, such for instance as crystals, increase in size, the process is not growth but "accretion" of new matter. This accretion is the addition of fresh particles from the exterior and there is no assimilation.

2. The actions of living beings are accompanied by a corresponding destruction of the matter by which these actions are manifested and the loss of matter is compensated for by the simultaneous assimilation of an equivalent amount of fresh matter.

3. Every living body, however humble it may be, and even if permanently rooted to one place, possesses, in some part or other, or at some period of its existence, a power of independent and spontaneous movement, a power possessed by nothing that is dead.

Living matter, so long as it is living, is the seat of energy and can overcome the primary law of the inertia of matter. Dead matter is entirely passive, unable to originate motion, and equally unable to arrest it when once originated.

Living differs from dead matter in its tendency to undergo cyclical changes.

In the ordinary course of nature, all living matter proceeds from preëxisting living matter, a portion of the latter being detached and acquiring an independent existence. The new form takes on the characters of that from which it arose; exhibits the same power of propagating itself by means of an offshoot; and, sooner or later, like its predecessor, ceases to live, and is resolved into more highly oxidated compounds of its elements. As Professor Huxley remarks, the present state of knowledge furnishes us with no link between the living and the not-living.

5. Living and dead bodies radically differ in chemical composition. The combining elements in dead bodies unite with one another in low combining proportions, and the resulting compounds for the most part consist of no more than two or three elements. The combinations of these elements may be said to be naturally in a state of stable equilibrium, and they show no tendency to spontaneous decomposition.

Living bodies are composed of few chemical elements and the combinations are always complex, consisting of three or four elements and these elements are united with one another in high combining proportions.

A large proportion of water is present in the chemical compounds of living bodies and these are prone to spontaneous decomposition.

Protein, the invariable basis of living bodies, is composed of 54 atoms of Carbon, 7 of Hydrogen, 14 of Nitrogen, 24 of Oxygen and 2 of Sulphur. This protein, united with a large proportion of water, forms the chief constituent of protoplasm.

6. Again most living bodies are composed of organs or separate parts which have certain definite functions in the general economy, and are said to be organized. Organization is not, however, an absolute necessity of vitality, as some living bodies are found that cannot be properly said to be organized.

7. Dead bodies have either no definite shape, and are then said to be amorphous, or are crystalline, and so bounded by lines and planes. Living bodies are bounded for the most part by curves and are of a definite shape. The shapes of living bodies can never be confounded with the amorphous and crystalline forms of dead matter, although sometimes they are found without a fixed form.

The conditions under which life can alone be manifested are of two kinds: The intrinsic or indispensable conditions, without which life is impossible; and the extrinsic conditions which are mostly present but not absolutely essential to the existence of living beings.

The first condition demands the presence of a physical basis and the second condition the presence of organisation, light and air, and a certain temperature.

The phenomena of life are associated necessarily with a particular form of matter termed the physical basis. The physical basis of life is named protoplasm, or better still, bioplasm. Naturalists are agreed generally that the presence of protein or protoplasm is an essential condition of vitality. It seems certain that no body unless composed of some form of this protoplasmic matter is capable of manifesting the phenomena of life.

There are, however, two different senses in which this statement is received. Some maintain that life is one of the properties of protoplasm, that protoplasm is not only a condition of vitality, but its very cause. Others and the more philosophic claim that protoplasm is merely a condition of vitality in the same sense that a metal rod or conductor is an essential condition of electricity. In discussing the question as to whether protein is a condition or cause of life, we must remember that we know only two factors of the case: That certain phenomena called vital, are exclusively manifested by living beings; and that these phenomena are never manifested except by a single form of matter, protoplasm, albumen or protein. Therefore, we conclude that there must be an intimate connection between vital phenomena and protoplasm or matter of life, but there is no warrant for the assertion that life is the result of protoplasm or one of its properties.

The more philosophical view as to the nature of the connection between life and its material basis, is the one which regards vitality as something superadded and foreign to the matter by which vital phenomena are manifested. A good conductor is necessary for the manifestation of electricity, but electricity can exist in a world entirely devoid of good conductors.

Among the extrinsic conditions, not actually essential to living beings, but generally present, is organization. Most animals consist of definite parts or organs, with fixed relations to one another, and each discharging its own work or function in the general economy.

Many eminent naturalists have claimed that life is so inseparably connected with organization that it must be regarded absolutely as the result of organization.

An examination, however, of the tiny creatures, Foraminifera, proves the contrary. These minute animals have no real organs, or organization. They consist of structureless and formless albuminous matter. They, however, exhibit all the phenomena of life.

They assimilate nourishment, grow, maintain their existence against hostile forces, have certain relations with the outer world, and reproduce their like. They manifest the highest functions of life without a single organ of any kind. Thus they show that organization is but a result of life, and not even a necessary result. Hence we see that an animal does not live because it is organized; it is organized or possesses structure because it is alive.

Light.—In one sense light is absolutely essential to life. All animals are dependent, mediately or immediately, upon plants for their food, for plants alone possess the power of building up organic compounds out of inorganic materials. Plants, however, ordinarily, can accomplish this feat of vital chemistry only when supplied with the chemical rays of the sun, so that light is absolutely required for life.

Again, some animals pass their entire life in total darkness, so that while light is necessary for animated nature as a whole, it is not essential to all living beings regarded as individuals.

Air.—Although certain low vegetable organisms, such as the bacteria, flourish in an atmosphere of Carbonic acid gas; still the presence of atmospheric air seems to be essential to animal life; and the presence of free oxygen may be considered as one of the extrinsic conditions of vitality.

TEMPERATURE.—The higher manifestations of life are generally considered possible only within a very limited range of temperature, or within 100° Fahrenheit, or from 32° to about 130°. Very low organisms, however, have been known to live within a much greater range, or from 20° to 300° Fahr.

WATER.—The physical basis of life or protoplasm demands the presence of a large proportion of water. Life, however, has been found in protoplasm, in a dormant condition, even in the total absence of water.

All the above named conditions are more or less essential for the existence of life, so much so, that the absence of any one of them ordinarily causes death. There are, however, some extraordinary exceptions to this. The Rotifers, microscopic creatures, but very highly organized, may be dried and reduced to dust, and kept in this state for an indefinite period of years. The addition of water will, after the lapse of all these years, restore their activity and vigor. These Rotifers, however, are merely in a state of suspended animation and are not really dead. This is an instance of revival but not a revitalization.

The microscope has demonstrated that the tissues of plants and animals are composed of an aggregation of minute elemental structures called cells. The morphological unit of the whole living world is the *cell*, which in its simplest condition is merely a spheroidal mass of protoplasm surrounded by a coat or sac called the cell-wall, which in vegetables contains cellulose, and in animals albuminous matter.

The cell is then the primary and fundamental form of life. The simplest or most degraded form of life yet discovered is seen in a Moner, called Bathybius, found by Professor Wyville Thompson, at a depth of 2,435 fathoms, in the Bay of Biscay.

The beings called Moners (Monera of Haeckel) are so simple in their structure, or rather, they are so entirely destitute of structure, that it is doubtful whether they are plants or animals. They are merely structureless living albuminous jelly. In the Moner, then, the organism consists wholly of what Professor Huxley and other writers call protoplasm, and Dr. Beale designates bioplasm, which is entirely structureless, since it exhibits nothing in the way of definite organs, and has, at most, a number of small particles or molecules scattered through it. Still, the little animal performs all the functions of nutrition and reproduction and manifests all the essential phenomena of life. (Bioplasm is colorless, transparent and apparently structureless. It is strongly tinged by an ammoniacal solution of carmine. It has the power of spontaneous movement or of extending itself in all directions in the form of mutable processes which can be withdrawn at will. Bioplasm has the extraordinary power of flowing through closed membranes without losing its identity or form.)

In some plants, termed unicellular, a single cell constitutes the entire organism, and in this solitary cell resides the power of both nutrition and reproduction. In the majority of cases, however, the organism of animal or plant is composed of a congeries of cells, each of which enjoys to a certain extent a life of its own, whilst its existence is, nevertheless, bound up with that of the whole.

The outer layer or membrane by which the cell is bounded is the cell-wall. It is not absolutely essential to the cell's existence, nor the agent by which cellular activity is manifested. The cell-wall appears to be formed from the outermost portion of the cell-contents by a process of transformation or partial death. The vital activity of the cell seems to be more or less governed by the nature of the cell-wall; the thicker and more developed becomes the cell-wall, the less efficient grows the cell.

The cell-contents, the all important element of the cell, are essentially of the nature of protoplasmic or bioplasmic matter. This is especially the case in young, actively growing cells, where the cell-wall bears but a small proportion to the cell-contents.

The cell-contents, however, diminish in bulk in progress of growth, owing to the transformation of their outermost layers into formed material or cell-walls. The cell-contents contain more or less numerous molecules and granules; they appear to be the main, and in some cases, the sole agent whereby the vital actions of the cells are carried on, and they constitute the only cell element the existence of which is constant.

The cell-contents contain generally, though not universally, a central dot or vesicle called the nucleus. The nucleus is oval or rounded; sometimes solid, sometimes vesicular and sometimes composed of granules. The nucleus plays an important part in cell-life, it is colored extensively with carmine and often takes the initiative in the process of cell-multiplication. The nucleus is not absolutely essential to cells, as it is not invariably present in them. The nucleus frequently contains in its interior a still smaller solid dot or particle called the nucleolus.

Cells have the power of perpetuating themselves, by producing fresh cells by the process of cytogenesis or cell-multiplication. Fresh cells are often produced within a parent-cell by the separation of the cell-contents into a greater or less number of distinct masses. The nucleus divides into two parts, and round each half the cell-contents aggregate so as to form two cells. These fresh nuclei divide again, giving rise to four cells and again to eight, and so on. This is the process of Endogenous cell-multiplication.

Gemmiparous cell-multiplication takes place when new cells are formed by little buds which are thrown out by a parent cell. It is termed Fissiparous cell-multiplication when the parent cell divides by cleavage into two or four parts, each of which becomes an independent cell.

Every animal, as well as every plant, no matter how highly organized, commences its existence as a simple cell, and the most recent biological researches teach, according to Huxley, that no cell has arisen otherwise than by becoming separated from the protoplasm of a pre-existing cell; whence the aphorism "Omnis cellula e cellula." No living cell can come from dead matter.

Chapter XVI.

RESULTS OF BIOLOGY.

(Spontaneous Generation?)

Spontaneous Generation, or Abiogenesis, is the doctrine that animals might under certain favorable conditions be produced without parents, or living beings could be directly produced from inanimate material or dead matter.

Materialistic naturalists have clung to this doctrine with a sort of desperation, for they have largely depended upon the establishment of abiogenesis and transformation of species to overthrow the Mosaic records and drive the Creator out of the universe.

Anaximander (610 B. C.), of the Ionian school of Grecian philosophers, and later Aristotle of the Peripatetics, expressed their belief in spontaneous generation, as indeed did all the naturalists of antiquity more or less implicitly.

This belief of the ancients was due to their incomplete knowledge regarding the real origin of many animal species. Thus, for instance, because maggots always appeared in putrefying meat at a certain stage of its decomposition, they were thought to be formed by spontaneous generation. Their existence could be accounted for in no other way, as no creatures were to be found there previously.

Francesco Redi (1668), of Arezzo, was the first to clearly enunciate the doctrine that living organisms must have originally sprung from preëxisting germs, and that in all cases of the apparent production of organized beings from dead matter, as in putrefaction and animal and vegetable infusions, the previous existence or subsequent introduction of such germs must be presumed. He exposed fresh meat, during warm weather, in wide-mouthed bottles, protected by pieces of paper fastened over their necks. In the bottles thus secured, no maggots were developed, notwithstanding that the putrefaction of the meat went on as usual; while in other similar vessels, unprotected by paper covers, maggots swarmed in abundance at the customary time.

It was evident therefore that their origin was due to something introduced from without, and it soon appeared that they were really the progeny of flesh flies, which, attracted by the odor of the meat, hovered over it until they gained access to it, and deposited their eggs upon its surface. The eggs then hatched into maggots, which, after a certain period of growth, became transformed into perfect insects similar to their parents.

This simple but conclusive experiment of Redi, completely overthrew for the time the doctrine of the abiogenists and demonstrated that in what had been supposed to be cases of spontaneous generation, the animals were really produced from parents like themselves.

Spallanzani (1767) by a long series of ingenious experiments, confirmed the results of Redi. He went much further than Redi and demonstrated that even in the case of the infusoria there was no spontaneous generation, but that these animalcules were produced from atmospheric germs.

Vallisneri, Swammerdam, Leuwenbock and other naturalists contributed additional arguments against the views of the abiogenists, so that from Redi's time to the present, the tide of scientific opinion has turned strongly and generally against spontaneous generation.

On the appearance of the microscope the question of abiogenesis was again opened, and it was contended by many scientists that though the rule "omne vivum e vivo" was applicable to the higher and more complex organisms, still, that Bacteria and the lowest Fungi and Protozoa were produced by spontaneous generation directly from dead matter.

The microscope discloses in animal and

vegetable infusions myriads of tiny living organisms, entirely invisible to the unaided eye. An organic infusion is a fluid holding organic matter in solution, and is obtained by soaking an animal or vegetable substance in water. If the infusion is exposed to the air for a certain length of time, it will become tenanted by a multitude of living organisms. A delicate film or scum is first formed upon the surface of the infusion, which, when examined under the microscope, is seen to consist of myriad moving molecules. The size of these points or molecules is almost infinitesimally small, and every increase of power in the instrument discloses smaller and smaller living and floating particles. These organisms are certainly living, as they are noticed to be in very active and incessant movement. Whether these moving organisms are animal or vegetable is not certainly known, but it is probable that they are partly the one and partly the other. With length of exposure, many of these particles are seen to grow in size, some being short and staff-shaped, and known as bacteria; and others long and worm-like and designated vibrios. It is very probable that both the bacteria and vibrios are vegetables.

At a still later stage of the exposure, the infusorian animalcules appear, which are most undoubtedly members of the animal kingdom.

The great question is, how did these living organisms get into this infusion? Were they generated spontaneously from dead matter or did they spring from germs previously existing in the air?

A few scientists still maintain the former view, while the many, the accurate and the skillful support the latter. This last school of scientists contend that the air itself, and fluids and even many solid bodies exposed to it, are swarming with the minute germs of living beings of both the animal and vegetable kingdoms. That these germs may remain dormant for great periods of time, have the power of withstanding temperatures that would be absolutely fatal to higher organisms; but can spring into active life when the surrounding conditions favor their development. These conditions are offered by organic infusions; and it is thought that the living organisms that appear in them are merely developed from the atmospheric germs which fall into them from the air or are already contained in the solution itself. Both the opponents and advocates of abiogenesis admit that organic germs are present in the air and in many other places as well. It may be laid down as established that the atmosphere, most fluids and many organic and inorganic substances, contain the germs of organisms which are capable of being developed into active life, when once they are placed under suitable conditions.

All nature teems with a life invisible except to the higher powers of the microscope, a life which reproduces itself by the ordinary and natural methods. The celebrated experiment of Professor Schulze of Berlin to determine whether the organisms found in infusions are produced abiogenetically or not, shows that with due precaution no animal or vegetable organisms appear when the liquid is absolutely protected from an access of the air. The experiment was uninterruptedly continued from the 28th of May until the beginning of August; "and when, at last, the Professor separated the different parts of the apparatus, he could not find in the whole liquid the slightest trace of infusoria or confervæ, or of mould; but all three presented themselves in great abundance a few days after he had left the flask standing open."

A vessel with a similar infusion, which he placed near the apparatus, contained vibriones and monads on the second day of the experiment, to which were soon added larger infusoria.

It is certain that the great majority of conscientious and skillful experimenters have found that if the infusion is properly prepared so as to destroy all organic germs in the liquid itself, and exclude those from without, no germs will appear.

Some experimenters, however, still claim that when using every precaution, the organic germs still appear or are spontaneously generated. Pouchet made this claim a few years ago, repeating, as he affirms, Schulze's experiment with great precaution.

Dr. Charlton Bastian is another who maintains that experiments made by him prove the occurrence of spontaneous generation. He took an organic infusion, boiled it to expel, as far as possible, the air and kill any germs that might be present in the fluid, and then hermetically sealed the neck of the flask in the flame of a spirit lamp. The flask was then submitted for hours to a temperature considerably above the boiling-point, and then allowed to remain unopened for a varying period. The doctor asserts that notwithstanding the vigorous tests he employed, the fluid in the flask after a certain time was almost invariably found to show under the microscope many living organisms, both of animal and vegetable nature. Knowing very well that the great majority of careful experimenters find an entirely different result from that of the

Doctor, it is natural to conclude that some fallacy lurks under his experiments.

It may be that he did not use a temperature sufficiently high to kill the germs, as it is well known that the living germs of some of the lowest animals and plants are not destroyed by a temperature equal to that of boiling water. Indeed some of the lowest forms of life may be able to endure conditions which at first sight might be regarded as inevitably destructive of vitality.

Mr. Calvert has lately shown experimentally that vibrios can endure a temperature in some cases exceeding 300° Fahr. without being killed thereby. It is fairly certain that life is destroyed in most of the higher organisms in a range of temperature between 104° and 208° Fahr. But it cannot be proven that this range is fatal to all living matter. The influence of temperature on life is greatly modified by the nature of the medium in which organisms are placed, and on the length of time the temperature is applied.

Most careful experimenters have found that if an ordinary infusion of hay is boiled but for a few minutes, no development of bacteria takes place in it, however long it may be kept; while if a little ammonia or potash had been added to the infusion it would not become sterilized until after an exposure to the temperature of boiling water for more than an hour.

Sometimes in the alkaline infusion, the bacteria were produced after an exposure of two hours and even after three hours. It is also found that a longer exposure to a lower temperature is equal to a shorter exposure to a higher temperature. For instance, an exposure of an hour and a half to a temperature of 212° Fahr. seems equivalent to an exposure of fifteen minutes to one of 228° Fahr. Thus the fact that Pouchet and Bastian exposed an organic infusion to a certain degree of temperature, and afterwards discovered living germs in the liquid, is not of the smallest value as proof that abiogenesis has taken place. There is no proof, for instance, that the organisms are dead after the boiling, except that their permanent incapacity to grow and reproduce their kind; and, again, since we know that conditions may largely modify the power of resistance of such organisms to heat, it is far more probable that such conditions existed in the experiments in question, than that the organisms were generated afresh out of dead matter.

Pasteur has been one of the most brilliant experimenters on the developments of organic infusions. He and his associates have established the existence in the air of extraneous particles, the introduction of which into an infusion was the necessary condition of infusorial life.

Jeffries Wyman demonstrated that bacteria might appear in closed flasks after boiling; but that the longer the boiling continued, the fewer the instances in which bacteria were afterward developed; and they never appeared in infusions which had been boiled continuously for five or six hours. Cohn observed certain bodies in connection with bacteria, which he designates as resting spores, or spores which do not immediately germinate, but remain quiescent for a certain interval and afterward become developed under other conditions.

According to Billroth, although the life of bacteria is destroyed by boiling, their resting spores will withstand this temperature, and are afterward capable of development into active forms. This may explain the occasional appearance of microscopic life in organic solutions which have been subjected to boiling.

Professor Huxley well remarks: "Not only is the kind of evidence adduced in favor of abiogenesis, logically insufficient to furnish proof of its occurrence, but it may be stated as a well-based induction, that the more careful the investigator, and the more complete his mastery over the endless practical difficulties which surround experimentation on this subject, the more certain are his experiments to give a negative result; while positive results are no less sure to crown the efforts of the clumsy and the careless."

But it is argued that the hypothesis of Evolution necessarily demands a belief in abiogenesis. So much the worse for evolution. Professor Huxley admits: "That at the present moment there is not a shadow of trustworthy direct evidence that abiogenesis does take place, or has taken place, within the period during which the existence of life on the globe is recorded."

But if materialistic evolution is true, living organisms must have arisen from not-living matter, because this hypothesis of evolution does not admit of a creative act, and insists moreover that this globe was once in the gaseous state.

The Evolution hypothesis of the materialists is that in the early stages of the earth's history, life could not possibly exist upon it, owing to the high temperature and the peculiar combination of its chemical elements, and as living beings subsequently made their appearance, they must necessarily have originated by the spontaneous organization of inanimate materials; and that these primitive and imperfect structures have gradually, by modification and descent, given rise to all the forms of animal and vegetable life now inhabiting the globe.

When the globe was in this glowing gaseous condition, living matter could not have existed in it, life being entirely incompatible with the gaseous state.

Rejecting the idea of a creative act, and driven from abiogenesis, these materialistic evolutionists adopt the hypothesis of Sir W. Thomson that the germs of living things have been transported to our globe from some other world. But no hypothesis could possibly be more absurd and ridiculous than this. Sir William in his anxiety to ignore the existence of God and the creative act, repudiates entirely his scientific instincts, for he is certainly a great scientist, particularly in the field of electricity.

No matter from abroad, from planetary or interstellar spaces, can reach the earth's surface without being enormously heated. Once any particle of matter comes within the earth's attraction, it is drawn with mighty force. When the body reaches our atmosphere, its velocity is very great and the friction of the air would raise it into the hundred of thousand degrees Fahr. The earth is moving in its orbit around the sun at a speed of 18 miles a second. This velocity alone would heat the body encountering our atmosphere to a very high degree of temperature, amply sufficient to absolutely dissipate into vapor any organic germs that might be found upon it. While the surface of such wandering bodies would be thus raised to a glowing heat, the interior is chilled with the cold of space, 400° Fahr. below zero. The heat of the surface and the cold of the interior would be alike absolutely fatal to living germs.

Chapter XVII.

RESULTS OF BIOLOGY.

(Transmutation of Species?)

To justly define the term species is one of the greatest difficulties in the whole range of Biology. The word itself is derived from the Latin, specere, to look, and signifies the natural appearance, the shape, form, quality or kind.

Webster defines species as a permanent class of existing things, or beings, associated according to attributes, or properties which are determined by scientific observation. These attributes differ in the different sciences. In the kingdom of life, a species is an ideal group of individuals resembling one another in essential characteristics, and capable of indefinitely continued fertile reproduction through the sexes.

A form resulting from variation which may be perpetuated by any mode of propagation, is called a variety or race.

The great Swede, Linnaeus, one of the most philososophic naturalists of all the ages, says: "Totidem numeramus species quot in principio formæ sunt creatæ" ("We reckon as many species as there were forms created in the beginning").

Linnaeus embodies in this famous formula the theory of creation and the permancy of species. He admitted the existence of varieties or the variability of species within a limited range.

This opinion of Linnaeus concerning species carries great weight, for he was a naturalist of transcendent merit, remarkable for his enthusiasm and untiring industry as well as for the systematic spirit of inquiry pervading his immense labors.

Naturalists generally have regarded species as unchanging throughout the longest succession of generations, except within narrow and marked limits, and have substantially adopted the definition of Buffon: "A species is a constant succession of individuals similar to and capable of reproducing each other."

Few works have ever met with such success as the Natural History of Buffon. It has been translated into most of the languages of Christendom. No naturalist that ever lived had deeper intuitions of the unitary laws of nature, physical, instinctual, and rational, than Buffon; and few writers on nature had more poetical views of truth and beauty than he. When he has declared himself so strongly for the fixity of species, it deservedly has great weight with naturalists.

"That which is the most constant and unalterable in nature," says Buffon, "is the type or form of each species; that which is the most variable and corruptible is the matter or the substance which clothes the form."

Lamarck, however, about the beginning of the present century denied the permanence and separate creation of species, declaring that existing forms of life have descended by true generation from pre-existing forms. He maintained that all species, man included, are descended from species of inferior organization; whilst to account for the simple forms found at the present time upon the earth, he claims that they are the product of spontaneous generation.

Lamarck "conceived that, an animal being brought into new circumstances, and called upon to accommodate itself to these, the exertions which it consequently made to that effect, caused the rise of new parts, on the contrary, when new circumstances left certain existing parts unused, these parts gradually ceased to exist. Something analogous was produced in vegetables, by changes in their nutrition, in their absorption and transpiration, and in the quantity of caloric, light, air, and moisture which they received. This principle, with time, is sufficient for the advance from the nomad to the mammal."

Thus, Lamarck rests his hypothesis chiefly on the well-known effect of use or exercise in changing and strengthening an organ, and of disuse in destroying or atrophying it.

Geoffroy Saint-Hilaire and others followed closely after Lamarck, but with more caution.

Lamarck's admirers and followers admit that he claimed entirely too much for the effect of use, or disuse. Use and disuse could never do what he demands of them. Even Darwin, who always moves with the greatest scientific caution, completely rejects Lamarck's notion, that new and simple forms are continually being produced by spontaneous generation. "I need hardly say," remarks Darwin, "that science in her present state does not countenance the belief that living creatures are now ever produced from inorganic matter."

In 1798, Lamarck was intrusted with the department of invertebrata in the museum of natural history in Paris. He became a great student of these inferior organisms and did a great deal for this branch of Zoölogy. He is the father of the doctrine of appetency, or that new organs could be produced in animals by the simple exertion of the will, called into action by the creation of new wants; and that the organs thus acquired could be transmitted by generation.

In support of his doctrine, Lamarck cites the existence of tentacles on the head of the snail, which derive their origin from the desire of the animal united with endeavor perpetuated and imperceptibly working its effect through a series of generations, to possess organs capable of examining the bodies it encounters; and the same thing has happened, he asserts, "to all races of gasterpods, in which necessity has induced the habit of touching bodies with some part of their head."

His greatest admirers are forced to admit that Lamarck as a naturalist is very markedly deficient in sobriety of thought, precision of statement, and coolness of judgment.

Lamarck is considered the modern originator of the hypothesis of the variation of species, because he first drew public attention to it. He was most enthusiastic in maintaining his doctrines and when he found facts wanting to support his views, he freely called upon his fancy to supply them. And Lamarck although a famous zoölogist, has rendered himself frequently ridiculous by his unlikely statements.

The greatest because the ablest advocate of the variability of species or the hypothesis of evolution, was Charles Darwin. He attributes to natural selection the office given to use and disuse by Lamarck. He maintains that variation in species is continually taking place owing to the external conditions to which plants and animals are subjected. In support of his position he adduces the changes which are known to result from domestication and cultivation. The weakest link in his chain of argument is his confounding of variety with species. He scarcely makes any distinction between these terms. He thus places the exception on an equal footing with the rule. Variety is the exception and species the rule.

Alluding to the selection that man must make in producing new breeds or varieties, he insists that nature has recourse to a similar selection, in the struggle for life, which all animals and plants must undergo. In this struggle the stronger or more favored organisms must overcome the weaker which latter must cease to exist.

He says that every animal and plant must maintain this struggle for life and be successful in maintaining it in order to its continued existence, not only against those creatures that make it their food, but also against those that feed with it upon the same nutriment. Thus, the possession of any slight advantage in the means of procuring food, or in the powers of offence or defence, may entirely displace less favored ones, and a slight variation of this kind which often takes place may be perpetuated.

The struggle for life is the fundamental principle of Darwinism. With Darwin the modifications thus introduced by the struggle for life account for the changes in organized beings from one geological period to another, and for the great differences in the plants and animals of different parts of the world. "Can it be thought improbable," says Darwin, "seeing that variations useful to man have undoubtedly occurred, that other variations needful in some way to each being in the great and complex battle of life, should sometimes occur in the course of thousands of generations? If such do occur, can we doubt—remembering that many more individuals are born than can possibly survive—that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. The preservation of favorable variations and the rejection of unfavorable variations, I call *Natural Selection.* Variations neither useful nor injurious would not be affected by natural selection, and would be left a fluctuating element, as perhaps we see in the species called polymorphic."

Darwin remarks that the effects of natural selection would best be seen in islands and countries surrounded by great barriers and regions undergoing strong physical changes. "In such cases," he says, "every slight modification, which in the course of ages chanced to arise, and which in any way favored the individuals of any of the species, by better adopting them to their altered conditions, would tend to be preserved; and natural selection would thus have free scope for the work of improvement."

As a further proof of his hypothesis of natural selection he declares: "That it is the common, the widely diffused, and widely ranging species, belonging to the larger genera within each class, which vary most."

The chief difficulty of his hypothesis, the absence or rarity of transitional varieties, he accounts for by supposing the predominant forms to have taken possession of their districts, whilst these were in process of being stocked; and that these districts, differing much in their natural characters, the forms originating in the comparatively unextensive intermediate tracts, have not been able to contend against them, and have become extinct. He points out the possibility that areas now continuous may not have been so during a long period, and that species may have been formed whilst they were broken up into islands.

Darwin goes on to say that: "several facts make me suspect that nerves sensitive to touch may be rendered sensitive to light, and likewise to those coarser vibrations of the air which produce sound."

Darwin depends a great deal on the unity of type throughout whole classes of creatures, and the homologies of parts very different from each other, as in the four-limbed structure of the vertebrates generally, and even the articulations of the limbs. He endeavors to trace the eye from the simplest to the most perfect form and to show how gradual are the transitions found on comparison of existing creatures, from the one to the other.

Darwin's treatise on hybridism is quite extensive and he tries to show that the general sterility of hybrids presents no insuperable objection to the hypothesis of a gradual modification of species, their sterility being incidental on other differences, and sterility occurring as he labors hard to prove, when varieties are crossed, as well as in the hybrids of distinct species.

Geology is the nemesis of the Darwinian hypothesis. The difficulties presented by geology, Darwin endeavors to obviate by insisting on the imperfection of the geological record. He does not indeed go so far as to adopt the view of some of his collaborateurs that the geological record exhibits to us a succession of animals corresponding in their progressive development with the foetal development of the mammalian embryo. But he points in his own defence to the many connecting links in the general system of nature which fossils seem to supply when compared with existing species.

He also tries to show that his hypothesis is consistent with the known facts of the geographical distribution of species, and in particular with the remarkable facts of the peculiarity of the fauna and flora of some of the lonely oceanic islands and of the frequent occurrence of the same species both in cold regions comparatively near the pole, and on mountains far remote from each other in lower latitudes; referring the latter class of facts to former geological periods, when the continental areas were not the same as now, or when the prevailing climatic conditions were very different.

He points to the correspondence without identity, of the faunas and floras of the northern parts of America and of the Old World in support of his position.

The claims of Darwinism or of the Hypothesis of Evolution may be reduced to a few leading heads, as follows:

"Although the individuals of the animal and vegetable kingdoms bear a general likeness to their progenitors, still they are not like them in every respect but slightly vary in some particular or other.

These variations, however slight, may be transmitted under certain favorable circumstances from generation to generation.

By breeding or artificial selection, man has produced races in which the variation has become permanent and frequently as widely different from the original progenitors as are some species from one another.

Our planet is changing and new conditions of life are constantly arising.

Animals and plants give rise to more progeny than can be preserved and the young not being exactly alike, natural selection will ensue whereby individuals possessing any variation favorable to the peculiarities of the species will tend to be preserved. Individuals wanting these favorable conditions will gradually disappear in the struggle for existence.

Individuals least adopted to their environment will be weeded out in this sifting process, while the "survival of the fittest" is secured.

The fortunate individuals will transmit to future generations the variations, to which they owe their preservation.

Thus varieties are produced, then races and with sufficient time (infinite) distinct species appear.

Given infinite time for the work of evolution on the surface of our globe all the animals and plants now flourishing may have been derived by natural selection from a single primitive being."

Admitting the insuperable objections against natural selection being alone a sufficient cause for the production by evolution of all existing species from pre-existing ones Darwin sought a supplementary cause in what he terms "*Sexual Selection.*"

Darwin maintains that among many of the animal species there is always a severe contest between the males for the possession of the females, these latter yielding themselves passably to the victors.

In these contests the victorious males must certainly have a natural advantage of some kind over the discomfited ones. The victors will have the more numerous progeny and these will perpetuate the advantage of their progenitors.

Again he asserts that in other animal species the choice of pairing lies with the female, the male being passive. The females select the more desirable males, Darwin claiming that color and song are the most potent factors in directing their choice. These attractions will be passed down and intensified from generation to generation and form well-marked breeds.

The following are the difficulties which the disciples of the Darwinian hypothesis have failed to answer satisfactorily upon the principle of natural selection: "Variations must exist before natural selection can take hold of them and preserve them.

Natural selection can preserve a variation but cannot initiate one. Natural selection has nothing whatever to do with the origin of a variation and variability in the individual must depend upon an internal law with which we are not acquainted.

The law that originates a variation must be of more importance than the one that preserves it. Unfavorable variations must be as common as favorable ones. The best that natural selection can do is to preserve the latter while it can produce neither.

Seeing that natural selection cannot occasion the most insignificant variation to demand any belief in it as a constant and universal agent in modifying all living beings, requires that variations should be continually occurring and that they should not be extensive in amount.

But the contrary we know to be true, that sudden and striking variations frequently occur for which no cause can be given and for which natural selection cannot possibly account. This very much enhances the probability that variability of every kind depends on some internal law entirely independent of outside conditions.

A favorable variation must occur simultaneously in many individuals to produce a new breed or variety. A variation, however favorable, has no chance of perpetuating itself unless it presents itself in more than one individual at the same time. But the probabilities are overwhelmingly against the simultaneous appearance of the same variation in numerous individuals of a species.

Thus while man with great care and wise intelligent choice may produce a new breed it is highly improbable that natural selection if left to itself, can produce a permanent new variety. The same parents may give rise to several groups of individuals differing widely in some characteristics from each other and from the parents, but which are sexless and so incapable of perpetuating their peculiarities by way of inheritance, and yet heredity is the only medium through which natural selection can operate."

The doctrine of evolution by natural selection requires that the variability of a species is indefinite. Now, while it is a well-known fact that the individuals composing any species vary more or less among themselves, still there is no proof that the variability of any species is indefinite. On the contrary, there are very strong reasons to show that each species is bounded by an uncertain but definite range of variability. And, however far apart the extreme terms of this range may lie, there runs between them the "line of safety" or normal line which is occupied by the individuals which are looked on as the type of the species.

The advocates of natural selection tell us that its action is extremely slow. The records of Geology show that geological time must have been really vast, still it would be no more than a mere drop in the ocean compared with the inconceivable lapse of time required by natural selection, according to the figures of its advocates, to do its work.

The essence of the doctrine of evolution by natural selection is the almost entire impossibility of one species being converted into another otherwise than by an extremely slow process, during which a vast number of generations lived and died.

We have certain definite data as to the duration of a species. For we know that many existing species have lived without change, during a very vast period of time. Both geology and astronomy claim to show that the space of time required by natural selection for the biological revolutions which we know to have occurred since the Laurentian period is a physical impossibility.

And Sir William Thomson demonstrates that there are good grounds to be drawn from other departments of physical science to show that the time which has elapsed since the appearance of life on the globe is far below that demanded by natural selection to accomplish the task demanded of it by its advocates.

H. Alleyne Nicholson, an impartial witness, says in his Biology: "The theory of the evolution of species by natural selection implies of necessity that one species can only be converted into another through the medium of a great number of successive forms, graduating into one another, each member of the series differing from its immediate neighbors in but minute characters. If, therefore, any existing species has descended from any pre-existing species, there must at one time have existed between the two species a graduated series of intermediate forms. When we consider the enormous number of living animals and plants, and the still more enormous number of extinct forms which we know, or may infer, to have existed in past time, it becomes clear—if evolution be true—that the number of minutely intermediate forms must have been incalculably great. We have therefore the clear right to expect that Palæontology should reveal to us such intermediate forms, amongst the vast series of fossil remains with which we are acquainted. We cannot, however, in any case point to such forms. It is quite true that there are many instances in which fossil animals may be regarded as intermediate forms between great groups of living forms, as missing links in the zoölogical chain. Such intermediate forms, however, are invariably sharply separated from the forms which they connect; and no case is yet known to us, even taking the Tertiary period alone, in which we can point to a graduated series of intermediate forms, by which one well-marked species can be shown to pass into another equally well-marked species."

Charles Darwin was undoubtedly a great naturalist. His work, "Origin of Species by means of Natural Selection," was probably the most remarkable volume of the century. It reached immediately a marvelous fame, perhaps because of the novelty, plausibility and sensationalism of its doctrine. But it is also remarkable for its literary merit, great research and shrewd scientific treatment.

Darwin was a voluminous writer on natural history and one of the very first to popularize science. He was, however, more of a writer on science than a worker in it. He certainly has not done the work for the natural sciences that Linnaeus, Cuvier, Buffon, De Condolle and Agassiz have done. His hypothesis, like all novelties and sensations in the scientific world, however popular and successful at first, is being tested in the crucible of facts and is declared a failure because it cannot satisfactorily answer the difficulties pressed against it. Darwin maintained the physiological relationship and community of origin of all living beings and attempted to account for the diversities of life on our globe by means of continuous development, without the intervention of a special creative act at the origin of each species.

The greatest names in the natural sciences have held different opinions and have declared his views to be unfounded.

The advocates of the doctrine of special creation claim that species are practically immutable productions, each of which has been specially created at some point within the area in which we now find it, subsequently spreading from this spot as far as the conditions of life were suitable for it. And when a species is found occupying two widely remote regions, it is in consequence of some geological change dividing the original area, or because the species had been carried accidentally to a distance from its primitive home.

As previously stated Linnæus and Buffon believed in the immutability of species.

The eminent De Candolle, who certainly stands in the foremost ranks of botanical science, says: "We unite under the designation of a species all those individuals that mutually bear to each other so close a resemblance as to allow of our supposing that they may have proceeded originally from a single being or a single pair."

The greatest of zoölogists, Cuvier, who first arranged the animal world under the four types of vertebrata, mollusca, articulata and radiata, defines a species as "a succession of individuals which reproduces and perpetuates itself."

Cuvier in his introduction to his Animal Kingdom also says: "There is no proof that all the differences which now distinguish organized beings are such as may have been produced by circumstances. All that has been advanced upon this subject is hypothetical; experience seems to show, on the contrary, that in the actual state of things varieties are confined within rather narrow limits, and, so far as we can retrace antiquity, we perceive that these limits were the same as at present. We are thus obliged to admit of certain forms which since the origin of things have been perpetuated, without exceeding these limits; and all the beings appertaining to one of these forms constitute what is termed a SPECIES. Varieties are accidental subdivisions of species. Generation being the only means of ascertaining the limits to which varieties may extend, species should be defined, the reunion of individuals descended from one another, or from common parents, or from such as resemble them as closely as they resemble each other." Cuvier believed in the absolute fixity of species.

Le Conte says: "The study of species, as they now are, would probably not suggest, certainly could not prove, the theory of their origin by derivation or transmutation."

And Asa Gray: "But organic things,

vegetables and animals, exist as *individual beings*. Each owes its existence to a parent, and produces similar individuals in its turn. So each individual is a link of a chain; and to this chain the natural-historian applies the name of SPECIES. All the descendants from the same stock therefore compose one species. And it was from our observing, that the several sorts of plants or animals steadily reproduce themselves,—or, in other words, keep up a succession of similar individuals,—that the idea of species originated. So we are led to conclude that the Creator established a definite number of species at the beginning, which have continued by propagation, each after its kind."

Agassiz and Gould in their Zoölogy: "The specific name is the lowest term to which we descend, if we except certain peculiarities, generally induced by some modification of native habits, such as are seen in domestic animals. These are called varieties, and seldom endure beyond the causes which occasion them. . . . . The *constancy* of *species* is a phenomenon depending on the immaterial nature. Animals, and plants also, produce their kind, generation after generation. We shall hereafter show that all animals may be traced back, in the embryo, to a mere point in the yolk of the egg, bearing no resemblance whatever to the future animal; and no inspection would enable us to declare with certainty what that animal is to be. But even here an immaterial principle is present, which no external influence can essentially modify, and determines the growth of the future being. The egg of the hen, for instance, cannot be made to produce any other animal than a chicken, and the egg of the codfish produces only the cod. It may therefore be said with truth, that the chicken and the cod existed in the egg before their formation as such. . . . It is a matter of common observation, that individuals of the same species have the same general appearance, by which their peculiar organization is indicated. The transmission of these characteristics, from one generation to the next, is justly considered as one of the great laws of the Animal and Vegetable Kingdoms. It is, indeed, one of the points on which the definition of species is generally founded."

Thus the men who have done the most for the natural sciences are a unit for the special creation and constancy of species.

Chapter XVIII.

RESULTS OF ANTHROPOLOGY.

(The Human Species.)

Anthropology is derived from the Greek, ἄνθρωπος, man, and λόγος, discourse, and is the science of man considered in his entirety as composed of a body and soul.

It is the highest branch of Zoölogy and embraces in some measure the sciences of Anatomy, Physiology, Psychology, Philology, Ethnology, Ethics and Sociology.

The question as to whether the human species is one or several, has divided anthropologists into Monogenists and Polygenists.

Monogenists say that all the races of men are derived from one common stock, that there is but one single human species, and that the differences of color, features and stature which distinguish the inhabitants of the different countries of the world are the result of accidental conditions which only form varieties of a primitive type.

The Polygenists assert that the above differences are fundamental and that the various human races must be regarded as several species entirely independent of each other.

As has already been remarked when treating of Biology the most illustrious naturalists, Cuvier, Linnaeus, Buffon, Humboldt, the two Geoffroys and Müller, however much they may differ on other doctrines, all perfectly agree in accepting monogenism.

Quatrefages says that: "Species is a collection of individuals more or less resembling each other, which may be regarded as having descended from a single primitive pair by an uninterrupted and natural succession of families."

The idea of resemblance, in this definition, is made of less importance and subordinate to that of filiation.

The same author defines Variety as: "An individual or a number of individuals belonging to the same sexual generation, which is distinguished from the other representatives of the same species by one or several exceptional characters."

When the characters peculiar to a variety become hereditary, that is, when they are transmitted from generations to the descendants of the first modified individual, a *race* is formed.

Quatrefages defines the Race to be: "A number of individuals resembling each other, belonging to one species, having received and transmitting, by means of sexual generation, the characters of a primitive variety."

It is universally admitted that the White and the Negro are the extreme types in the human series. Polygenists claim that the differences between the White and the Negro are too great to allow them to be classed in the same species.

On the contrary, the monogenists seem to find very little difficulty in demonstrating that the limits of variation in animals and plants are almost invariably greater than between the White and the Negro, the two extreme races of the human kind.

In vegetables, flowers and fruit-trees the limits of variation are very extensive indeed. The cabbage numbers forty-seven principal races, each being divided into numbers of secondary and tertiary ones and all of one only species. The distance which separates the headed cabbage from the cauliflower is immensely greater than that between any of the races of man.

We will be forced to the same conclusion in regard to animals, too, if we compare them with man, organ for organ.

Color is one of the most striking features of the different races of men. Yet melanism is more apparent in the many races of animals and fowls than in man. The skin of the white poodle is white, although black is the ordinary color of dog skin. Dogs and horses vary from one extreme of color to another, and oftentimes assume a white hair on a black skln. Domestic fowls of French breed have a white skin; those of Cochin China a shade of yellow; there are black fowls with a black skin; and the silk hen of Japan has a dark skin beneath white feathers. Color is not a specific but an accidental difference and depends on circumscribed and transitory modifications. Linnæus remarks on the head of color: "Nimium ne crede colori."

The modifications of the hair and of the villosities in general in human races are much less marked and extensive than in the varieties of animals of the same species. All men possess hair, whereas it is well known that there are hairless dogs, horses and oxen. With mankind hair remains hair however the race may vary, whether coarse, stiff, fair, black or wooly; or whether the transverse section be circular, oval or elliptical. On the contrary the wooly fleece of sheep is in some countries replaced by short smooth hair, and the hair of the wild boar by a sort of coarse wool.

In regard to variation in size it is found by actual measurement to be twice as great in the horse as in man, three times in the sheep and rabbit and four times as great in the dog. The stature of the Patagonian to that of the members of the Akka tribe is as three to two, while the size of the St. Bernard to the small spaniel, or of the stately greyhound to the beagle, is as five to one.

The modifications of the head in the varieties of animals of the same species are much greater than in the different races of men. There is a greater difference in the heads of the wild boar and the domestic pig, in the heads of the bull-dog, greyhound and spaniel, than in the White and the Papuan. The oxen of Buenos Ayres have preserved the horns while those of Mexico have lost them.

In regard to a number of anatomical characters there is a much greater difference between races of animals of the same species than between the human races. There is a rudimentary fifth toe in the hind-paw of some races of dogs which disappears in others. In some races of pigs a third medial toe is developed, while normally this animal has two medial toes.

In some races of dogs, sheep and goats the tail is reduced to a short coccyx.

Such marked anatomical variations as these and others that might be named are never found in mankind.

The specific unity of all mankind is not only demonstrated on morphological grounds or by external resemblance, but still more strikingly and conclusively on physiological ones. In the crossings between the different races of man, we have a means of determining whether the different human groups are only races of a single species, or rather distinct species.

When sexual unions take place, in plants and animals, between races of the same species and between different species, we have what is called a *cross*. In the first named instance the cross produces a *mongrel*, and in the second a *hybrid*. The product of the union of mongrels is called a mongrel, and of hybrids a hybrid when the cross unions are fertile.

The phenomena presented in the crossing of human groups must be compared with those witnessed in the crossings of animals and plants in relation to the production of mongrels and hybrids. If the crossings of the human groups have the character of hybridism, then as in the case of animals and plants, we must conclude that the human races are specifically distinct and form many human species; but if, on the contrary, these crossings bear the stamp of mongrelism it follows that the groups are only races forming one human species.

Mongrelism may be natural or artificial. Linnaeus was the first to discover the distinction of sexes in plants and soon after his discovery proved that mongrels could be produced in plants as in animals. M. Naudin by a multitude of experiments demonstrated the fertility of the crossings between races of plants. Isidore Geoffroy of the Paris Museum proved that mongrels between the different races of sheep, dogs and pigs were invariably fertile. Every gardener and breeder knows very well that he can without difficulty succeed in breeding races of mongrels that are fertile among themselves. All known facts attest the perfect fertility of mongrels.

Hybrids, on the other hand, or crosses between species, exhibit facts of an entirely different nature.

The production of hybrids may be either natural or artificial. The former is so rare that its reality has been doubted altogether by the most eminent naturalists. It is especially rare among wild animals, and Isidore Geoffroy claims that it is entirely unknown among mammalia. It is also unknown among fishes. In domestication among the order of birds there are a few rare exceptions of spontaneous crossings between different species.

The intelligent intervention of man has succeeded in a few exceptional cases in producing crossings between a very limited number of different species of animals and plants. And all experimenters agree that when unions have been successful between different species the fertility is immediately diminished in immense proportions.

Buffon and Daubenton succeeded but twice in their whole career in producing crossings between he-goats and sheep, Titires; and between the ram and the she-goat, Musmons, although they made numberless experiments. Isidore Geoffroy invariably failed in his endeavors to do so.

It is the conclusion of science that there are only two species of mammals, the ass and the horse, the crossing of which is really fertile. Hybridation among animals and plants when left to themselves is most extremely exceptional. Man has succeeded with the greatest difficulty in producing a few rare cases of it.

Again it is an incontestable fact that mongrels retain, during an indefinite number of generations, the faculty of reproducing and transmitting to their descendants the mixed character they inherited from the first parents, which effected the cross. Buffon, the two Geoffroys St. Hilaire and Darwin are unanimous on this point and have demonstrated its truth by a multitude of experiments.

Breeders and gardeners take advantage daily of this property of mongrels to improve and modify many varieties of animals and plants. Several races of a single species will intermix in every degree if in habitual contact and left to themselves. This result of free intermixing would lead through insensible shades to the different primitive types. It is in this way that the races of our domestic dogs and cats have come into existence, which continue perfectly fertile notwithstanding numberless crossings of every kind.

Man can with care regulate the crossing between two races and obtain a mongrel race. This new race becomes settled and consolidated after a few oscillations between the paternal and maternal types.

However great may be the constancy acquired by the new mongrel race as a whole, it almost invariably happens that some individuals reproduce more or less faithfully the characters of one of the types originally crossed. This reproduction, in individuals, of the characteristics of the primitive types is called *Atavism*. Atavism (Lat. Avus, grandfather), then, is the recurrence of the original type of a species in the progeny of its varieties.

Fertility in the broadest acceptation of the term, in animals and plants, between themselves and between all the races of the same species, is one of the characters of mongrels. Atavism sometimes occurs in the midst of a race considered to be perfectly pure, resulting from a single crossing several generations back; and it attests the physiological bond which unites all mongrels.

The law of sterility of species is as firmly and absolutely demonstrated in the organic world as that of attraction in the sidereal world. Should the law of attraction be suppressed in the inorganic world, general chaos among the heavenly bodies would be the result.

Suppress the law of the sterility of species and in a short period the animal and vegetable kingdoms would fall into complete disorder.

M. Godron has shown that in vegetable hybridism the physiological equilibrium is destroyed at the expense of the organs conducive to the life of the species in favor of those conducive to the life of the individual. The leaves and stalks relatively to the flowers are developed in an exaggerated degree. Among animals the case of the mule, the most common animal hybrid, is exactly similar. The mule is always stronger, more robust and hardy than its parents, but is always sterile.

With plants sterility is not absolute among all hybrids of the first generation; still although in a very few of these the elements which characterize the two sexes remain capable of reproduction, the fertility is always however immensely reduced. The male is the one generally affected in an entirely special manner. Two hybrids of the first generation uniting together produce hybrids of the second generation. Hybrids of the second generation are as a rule either sterile or there is a spontaneous returning to one or other of the parent types. This latter is reversion.

In some extremely rare instances fertility continues during a number of generations, resulting in the curious phenomenon of disordered variation. M. Naudin followed one of these hybrids through seven generations and discovered that some of the individuals of each generation reverted to the characters of either of the original parents, and that the others resembled neither the original parents, nor the hybrids resulting from the crossings, nor was there any resemblance between the plants themselves.

Thus the crossing of species does not produce a race, even where there is a certain amount of fertility; *producing* only a variety incapable of transmitting their individual characters.

Hybridism in the animal kingdom presents if possible still greater infertility than in the vegetable world. Thus the only two species the crossing of which displays anything approaching to regular fertility, the horse and the ass, merely produce a hybrid, the mule, absolutely devoid of fertility.

The sterility of the mule was perfectly known to Herodotus and Pliny.

As among plants there seem to be a very limited number of animals, particularly among birds, not entirely subject to the general law of the sterility of hybrids. But even here the faculty of reproduction in the males is constantly weakened, and habitually disappears before the usual age; the female lays more rarely, and the eggs are fewer in number and very often clear.

By crossing and recrossing in a fixed manner the goat and the sheep, hybrids, *chabins*, are produced which have three eighths of the paternal and five-eighths of the maternal blood. These chabins can be maintained for a few generations but finally return like plants to the paternal types by reversion.

The leporides, resulting from a cross between the hare and the rabbit, present the same phenomenon of disordered variations and reversion.

The Agricultural Society of Paris demonstrated that the leporides after a few generations reverted entirely to the rabbit type.

There is a vast and radical difference between atavism and reversion. The mongrel which by atavism reassumes the characters of one of its paternal ancestors still preserves its mixed nature. It is different in the cases of reversion displayed by hybrids, for one of the two bloods is irrevocably expelled.

Atavism is characteristic of crossing between races and reversion of crossing between species. In the case of atavism there is a possibility of the offspring of the first or second generation reproducing the essential traits of its own maternal ancestors. Giron de Buzareingues furnishes a striking example illustrative of this reproduction. He noticed it in a family of dogs, crosses between the setter and spaniel. A male of this family, to all appearances a setter, united with a female of pure setter breed, producing spaniels, which fact makes it very clear that the spaniel blood had not been annihilated, and that the return to the setter type was only apparent.

On the contrary it is well known that Titires and Musmons have never in all their history had offspring affected by atavism. A ram and sheep have never produced a kid, nor a male and female goat, a lamb.

Hybridism among animals has never in any degree given rise to a series of individuals descended the one from the other, and preserving the same characters.

Hybridism is then occasioned chiefly by

man's interference; is extremely rare; is sterile; and even when successful gives rise to the phenomena of reversion and disordered variation; or as Quatrefages remarks: "The characters of hybrids are Infertility, as a general rule, and, in the exceptions, a very limited fertility; series suddenly cut short either by infertility, by disordered variation, or by reversion without atavism. . . . Species is then a reality; and science may affirm that from all appearances each species has had, as point of departure, a single primitive pair." (Human Species, page 84.)

Long series of experiments have thus clearly marked the distinction between species and races. Are then the human groups races or species? The white man has penetrated to every portion of the habitable globe. He has mixed with every human kind and mixed races have everywhere sprung up in his track. These mixed races are most broadly fertile, much more fertile than the original races from which they sprang. And this fertility depends upon no other circumstances than simply upon the physical connections existing between all men from the lowest of the Negroes to the first of the Whites.

Le Vaillant gives an instance of the great fertility of mixed human races: "Hottentot women with husbands of their own race have three or four children. With Negroes this number is tripled, and it is still further increased with Whites."

Hombron speaking of a long experience in Brazil, Chili and Peru, says: "I am able to state that Unions of Whites with American women have given the highest average of births. Next came the Negro and Negress. And thirdly the Negro and the American woman."

Crossings between races could alone present facts of this kind. In crossings between species, as previously demonstrated, fertility invariably diminishes in an immense ratio. Thus human groups, however different they may appear to be, are but races of one and the same species and not distinct species, for invariably their crossings exhibit the characteristic traits of mongrels and never in any respect of hybrids.

It is thus as clearly demonstrated as a proposition in geometry can possibly be that there is but one human species. This is the conclusion of Linnaeus, Buffon, Cuvier, Geoffroy, Müller and Humboldt.

Man could not, therefore, have come by transmutation from a lower species, as specific evolutionists claim, but by a special creative act of the Almighty, as the Mosaic record declares.

Genesis tells us that God created man to his own image; to the image of God he created him: male and female he created them. Evolutionists deny this declaration of scripture, asserting that there was no need of a creative act, that the human race came in a natural way through an almost indefinite series of gradations from inert matter itself. Evolutionists rely upon Biology and Anthropology to establish their theories. But both Biology and Anthropology very plainly and positively favor the statement of Moses.

The first and fundamental principles of Biology teach that animals and plants are composed of cells; that the cell is the morphological unit of the whole living world; that no cell has arisen otherwise than by becoming separated from the protoplasm of a pre-existing cell; that no living cell can come from dead matter.

The most eminent and most careful experimenters have demonstrated that abiogenesis or spontaneous generation is an impossibility. The men who have done the most for the natural sciences are a unit for the special creation and permancy of species. It is as true as a proposition in geometry that there is one only human species. Thus link by link Biology and Anthropology have woven a firm and glittering chain of irrefragable argument, showing that it is absolutely impossible for man to have been evolved by transmutation from any inferior species, but must have come by a special creative act of the Almighty as the great Hebrew Prophet records.

Chapter XIX.

RESULTS OF ANTHROPOLOGY. (Con.)

(Man not of Simian Descent.)

Biology may be said to be divided into two great camps concerning the problem of man's origin. One camp claims a separate creation for man, the other derives him by gradual transmutation, development or evolution from the lower animals.

Agassiz, who eminently represents the first school or creationists, says: "There is a manifest progress in the succession of beings on the surface of the earth. This progress consists in an increasing similarity to the living fauna, and, among the vertebrates especially, in their increasing resemblance to man. But this connection is not the consequence of a direct lineage between the faunas of different ages. There is nothing like parental descent connecting them. The fishes of the Palæozoic age are in no respect the ancestors of the reptiles of the Secondary age, nor does man descend from the mammals which preceded him in the Tertiary age. The link by which they are connected is of a higher and immaterial nature; and their connection is to be sought in the view of the Creator himself, whose aim in forming the earth, in allowing it to undergo the successive changes which geology has pointed out, and in creating successively all the different types of animals which have passed away, was to introduce man upon the surface of our globe." (Principles of Zoölogy, pp. 205–6.)

The Evolutionists or Darwinians maintain on the contrary that man has come by successive generations and transmutation from the very lowest form of animal life.

Darwin says: "The earliest ancestors of man were without doubt once covered with hair; both sexes having beards; their ears were pointed and capable of movement; and their bodies were provided with a tail having the proper muscles. Their limbs and bodies were acted on by many muscles, which now only occasionally reappear in man, but which are still normally present in the quadrumana. The great artery and nerve of the humerus ran through a supracondyloid foramen. At this, or some earlier period, the intestine gave forth a much larger diverticulum or coecum than that now existing. The foot, judging from the condition of the great toe in the foetus, was then prehensile, and our progenitors, no doubt, were arboreal in their habits, frequenting some warm forest-clad land; the males were provided with canine teeth which served as formidable weapons." Again, Darwin in another place goes on to say: "The Catarhine and Platyrhine monkeys agree in a multitude of characters, as is shown by their unquestionably belonging to one and the same order. The many characters which they possess in common can hardly have been independently acquired by so many distinct species; so that these characters must have been inherited. But an ancient form which possessed many characters common to the Catarhine and Platyrhine monkeys, and others in an intermediate condition, and some few perhaps distinct from those now present in either group, would undoubtedly have been ranked, if seen by a naturalist, as an ape or a monkey. And as man under a genealogical point of view belongs to the Catarhine or Old World stock, we must conclude, however much the conclusion may revolt our pride, that our early progenitors would have been properly thus designated. But we must not fall into the error of supposing that the early progenitor of the whole Simian stock, including man, was identical with, or even closely resembled, any existing ape or monkey." (Descent of Man, part i. ch. 6.)

Darwin and Haeckel regard the monera as the first ancestor of all living beings. Man has come from the monera by passing through twenty-one typical transitory forms. Our nearest ancestor is now considered by transmutationists to be the tailless catarhine apes, such as the gorilla.

Indeed, evolutionists regard the gorilla as on the whole the most anthropomorphous ape. It is acknowledged, however, that no one of the now living species of apes was the immediate ancestor of man. The Orang most closely resembles man in respect to the structure of the brain; the Chimpanzee in the form of the skull; the Gorilla, in the development of the hands and feet; and the Gibbon, in the formation of the chest.

The most sanguine transmutationists confess that there is a missing link. Haeckel calls this link the pithecoid-man or ape-man. This being is purely hypothetical and not the slightest vestige of which has ever been found. Whereas had it ever really existed it would have left its record in the earth's crust in myriads of fossils.

Darwin, too, admits the necessity of this link between the ape and man. The ape and man differ essentially in respect to type. Their organs closely correspond term for term, but are arranged after a very different plan.

The arrangement of the organs in man is such as to essentially constitute him a *walker*, while in the ape they as forcibly necessitate his being a *climber*. A walking animal cannot be descended from a climbing one. This alone is proof sufficient that man could not come from the ape.

There is moreover a most striking difference between man and the highest apes in the general proportions of the body and limbs. The greatest difference is noticed in the structure, size, weight and convolutions of the brain.

The gorilla's brain-case is smaller, its trunk larger, its lower limbs shorter, its upper limbs longer proportionately than man's. There is truly a vast difference between a man's and a gorilla's skull. The face in the gorilla, formed chiefly by the great jaw-bones, predominates over the cranium or brain-case, while in man the cranium predominates over the face. The gorilla which goes on all fours ordinarily, and whose skull is inclined forward, has the occipital foramen, through which the spinal cord passes, far back behind the center of the base of the skull, whereas in man the foramen is placed just behind the center of the skull's base. The smallest adult human cranium scarcely ever measures less than 63 cubic inches, while the largest gorilla cranium measures no more than 34½ cubic inches.

It is certain that the difference between man and the apes depends, most of all things, on the relative size and organization of the brain. The brain of the highest apes is much less complex in its convolutions than is man's. The weight of a gorilla's brain hardly ever exceeds 20 ounces, whereas man's scarcely ever weighs less than 32 ounces, although the gorilla is very much the larger animal of the two.

There are a multitude of other anatomical differences between man and the higher apes. Professor Huxley says that: "Every bone of the gorilla bears a mark by which it can be distinguished from the corresponding human bone, and that, in the present state of creation at least, no intermediary being fills the gap which separates man from the troglodyte."

Pruner Bey, after much research, has brought out the fact that there exists almost invariably an inverse order in the development of the principal organs of man and the anthropomorphous apes. The experiments of Welker have led to the same conclusion. Welker found that in man the sphenoidal angle diminishes from the time of birth, whilst in the ape it is always increasing.

The researches of Gratiolet further show that in the ape the temporal sphenoidal convolutions which form the middle lobe, appear and are completed before the anterior convolutions which form the frontal lobe. In man there is an inverse order, the frontal convolutions appear first and those of the middle lobe are formed subsequently. How can any organized being be a descendant of another whose development is in an inverse ratio to its own? So that man cannot be considered as descended from any of the Simian types.

It must be remembered that between man and the rest of the vertebrata numerous relations exist, for all the vertebrata of which man is a species are constructed upon the same fundamental plan. The difference between man and the vertebrata depends mostly upon the nature of the brain.

And the most important fact in connection with the brain is not its absolute development. It is the relation of this development to that of the rest of the body.

Duvernoy has made out a table showing the proportion of the brain to the rest of the body in a number of animals. According to this table the Blue Tit, the Cole Tit and the Canary have a much stronger claim to be man's ancestors than any Simian race.

Many sanguine scientists have sought for the fossil of the Pithecoid man or missing link in Asia, the cradle of the human species, but none has ever been found there. The slightest traces have never been discovered.

Others, with Darwin, have placed the fossils of this missing link beneath the Atlantic Ocean. But this hope has been absolutely dissipated. The expedition of the "Challenger," sent out by the British government, declared in their published reports that no such continent as an Atlantis has ever existed. Mr. John Murray, whose testimony no scientist will dispute, says: "He is a bold man who still argues that in the tertiary times there was a large area of continental land in the Pacific, that there was once a Lemuria in the Indian Ocean, or a continental Atlantis in the Atlantic!"

At the same time that intelligence is a bond of union between all the races of man, showing that they are all of one family, it places an enormous gulf between the family of apes and the family of man. Almost all scientists acknowledge that intelligence shows an immeasurable and practically infinite divergence between man and the lower animals. The opinion is deeply rooted in modern as in ancient thought, that only a distinctively human element of the highest import can account for the severance between man and the highest animals below him. "The distinction does not seem to be principally in the range and delicacy of direct sensation, as may be judged from such well-known facts as man's inferiority to the eagle in sight, or to the dog in scent. At the same time, it seems that the human sensory organs may have in various respects acuteness beyond those of other creatures. But, beyond a doubt, man possesses, and in some way possesses by virtue of his superior brain, a power of co-ordinating the impressions of his senses, which enables him to understand the world he lives in, and by understanding, to use, resist, and even in a measure rule it. No human art shows the nature of this human attribute more clearly than does language. Man shares with the mammalia and birds the direct expression of the feelings by emotional tones and interjectional cries; the parrot's power of articulate utterance almost equals his own; and, by association of ideas in some measure, some of the lower animals have even learnt to recognize words he utters. But, to use words in themselves unmeaning, as symbols by which to conduct and convey the complex intellectual processes in which mental conceptions are suggested, compared, combined, and even analyzed, and new ones created—this is a faculty which is scarcely to be traced in any lower animal." (E. B. Tylor.)

But what particularly isolate man from animals are moral and religious phenomena. These belong essentially to the human kingdom; they are the special attributes of the human species. There is no human society in which the idea of good and evil is not represented by certain acts regarded by the members of that society as morally good or morally bad.

Wallace, from his experience among the Kurubars and Santals, has found that these tribes have a consciousness of moral good and truth anterior to experience, and independent of questions of utility.

The peoples of every nation, however low or savage, have a moral sense. Conscientious travellers tell us that the most inferior races have honesty, respect for human life, and self-respect.

The right of tribal property known as the hunting-grounds is respected by the Redskins, the peoples of New Holland, among the lowest in the human scale, and by the Australians. The peoples of one tribe will not enter the hunting-grounds of a neighboring tribe without express permission. Among the most savage peoples theft is regarded as something wrong and is punished. Among savage peoples, however, it is not regarded as a theft to rob an enemy or a stranger. It is, on the contrary, considered a meritorious act. Savage peoples have a great respect for property rights among themselves and the thief is punished as severely on the Guiana coast as in the United States.

The Australian, uncorrupted by the vicinity of the White, kills the one who has destroyed the purity of his wife, and with the Hottentots, death is also the punishment for adultery.

Respect for human life is universal among the races of man, and the murderer is everywhere punished. This formula is supposed to be more elastic with the Savage than the White, and still it is safe to say that no human race has so terribly sinned against respect for human life as the White race.

A love of honor is especially characteristic of savage races, and nothing is more common than to see savages prefer death and even torture to shame.

Modesty and politeness, marks of self-respect, are shown by savages, but in a way different from our own. We uncover our head before a superior, the Turk remains covered and the Polynesian sits down.

All human groups are not upon the same moral level, but every group has the moral faculty more or less developed. The universality of religion among mankind is now all but admitted; all the groups of man are religious.

All the peoples of the globe profess a belief in beings superior to themselves and capable of exercising a good or evil influence upon man's destiny; and the conviction that man's existence is not limited to the present life, but that there remains for him a future beyond the grave.

Travelers, through mistake, want of knowledge of the language of the people, or preconceived opinions, have from time to time reported that groups of mankind were atheistic and without religious belief, but this, by reason of superior knowledge, has all been corrected. Thus, D'Orbigny says of the races of South America: "Although several authors have denied all religion to certain Americans, it is evident in our opinion that all the nations, even the most barbarous, possessed one of some kind."

De Mofras tells us that the Californians believed in a superior God and that: "This God has had neither father nor mother. His origin is entirely unknown; they believe that He is omnipresent; that He sees everything, even in the middle of the darkest nights; that He is invisible to all eyes; that He is the friend of the good, and that He punishes the wicked."

According to the testimony of Major Michael Symes and Mr. Day, the Mincopies, one of the lowest tribes in the social scale, worship the sun as the principal god and the moon as a secondary god; and the genii of the woods, rivers, and mountains as agents of the first divinities.

Kolben testifies that the Hottentots believe in a God, the creator of all things, whom they style the God of Gods. They regard the moon as an inferior deity. They believe in another life and dedicate to the ghosts of their great men fields, mountains and rivers.

The Bachapine Kaffirs believe in a superior but malevolent being, whom they call Mouliimo. The Basutos admit the existence of a being who destroys by thunder, and believe in another life to be lived in the center of the earth.

The Australians, the Tahitians, the Negroes of Guinea and the peoples of Dahomey all have their native religions.

Nowhere on the earth is found a great human race, or a large portion of it, professing atheism. The religious faculty is common to all human beings; it is one of the fundamental characters of the human species; it gives a specific kinship to all human races and utterly divides them from any Simian origin.

Thus the truest results of Biology and Anthropology, instead of contradicting, confirm the Mosaic record. God called man into being by a special creative act. The whole human family belongs to the one same species, and man's Simian descent must be abandoned.

Chapter XX.

RESULTS OF ANTHROPOLOGY. (Con.)

(*Origin of Races.*)

The best science, then, may be said to have established the fact that there is but one human species branching out into a great variety of races; and that all the races of men are specifically identical in anatomical and physiological qualities; and in particular in intellectual and moral attributes.

The aim of this chapter is to show that the various human races, having one and the same origin and springing from a single primitive pair, have received their differentiations from the multiple conditions of life. Thus the very best and truest science unequivocably confirms the Mosaic account of the descent of man. Acclimatization and naturalization have successively determined and fixed the different races as mankind established themselves in the different countries of the globe.

Anthropologically speaking, it may be said to be a very difficult, if not, indeed, an insoluble problem to determine the geographical position of the center of appearance of the human species. The solution at best can be but approximative.

Quatrefages places the human cradle in that region of Asia bounded on the South and South-west by the Himalayas, on the West by the Bolor mountains, on the Northwest by the Ala-Tau, on the North by the Altai range and its off-shoots, on the East by the Kingkhan, on the South and Southeast by the Felina and Kuen-Loun.

No other portion of the earth presents a like union of extreme human types distributed around a common center. The three great fundamental types of all the human races are represented in the peoples grouped round this region. The Black, the Yellow and the White races all flourish here together to-day side by side.

The three great fundamental forms of human language are found in this same region. The monosyllabic languages are represented in the Central and South-East portion of this territory, the agglutinative languages in the North-East and North-West, and the Inflectional languages in the South and South-West.

Again, naturalists, and particularly Geoffroy and De la Malle, claim that from Asia the earliest domesticated animals are derived.

This great Asiatic enclosure would then appear to be the first home of the human family.

Thus far anthropology has taught us that there is but one species of man, and that the many human groups are races. The human species are localized originally in a very limited space. Human beings are now found the world over and it may be easily shown that this peopling of the globe is the consequence of migrations.

The history, traditions and legends of both the new and the old world show Migrations to be universal among men. Palæontology and archæology add their testimony to the wandering instincts of man.

The continued immobility of a single human race is contrary to all analogy.

As far as land barriers are concerned, none of them have been entirely insurmountable to man's passage. Man has always been able to vanquish ferocious animals, to climb the highest and most precipitous mountains, to traverse deserts and cross rivers.

Man alone has been able to dispute effectively the onward march of man. Where man did not exist there was no insurmountable barrier, and even when a country had been inhabited, a superior invading force could not be stopped.

Neither do the oceans with their adverse winds and currents form an altogether impassable barrier to human migrations. Polynesia, on account of its ocean barriers, is regarded as one of the least accessible places possible to human migration. Yet from the testimony of creditable navigators it now seems to be admitted as an established fact that a maritime people thoroughly acquainted with the Malay Archipelago could have easily sailed as far as New Guinea. From New Guinea any fairly bold navigator could have reached the Fiji Islands, and from here Polynesia was easily accessible.

Autochthonists object to this, however, the universality and absolute constancy of the trade winds in these regions, which would prevent the passage of these seas by any navigator however bold, depending upon the crude methods of ancient science.

We have, however, the testimony of Maury and Kerhallet that there are at seasons variable winds extending over an area of twenty degrees of this region. It is now known also that the monsoon drives back yearly the trade winds and blows beyond the Sandwich and Tahiti Islands.

Thus everything for a part of the year would favor navigation eastwardly. Moreover there runs from east to west in the Pacific the great equatorial current. This current is found to consist in reality of two distinct oceanic streams, one of which, to sustain the equilibrium, runs in a contrary direction to the other. The one running eastwardly skirts the northern portion of Polynesia.

The Pacific as well as other oceans, has its typhoons and tempests blowing in all directions. This ocean is full of islands which must have often been reached and made the home of shipwrecked sailors.

Everything seems to point to the theory that Polynesia was peopled by Malays migrating from west to east. All travelers agree that the Polynesians belong to the same race as the Malays and speak the same language with slight variations of dialect.

Polynesia has an area of greater extent than the whole of Asia.

With regard to the peopling of America by migrations from other continents, there is very little geographical difficulty. The Asiatic races could have passed into North America across Behring Straits without much trouble. The narrowness of the channel between the continents and the presence there of the St. Lawrence Islands would greatly facilitate the passage between the main lands.

Again, the *Kouro-Sivo* or *Black-stream* of the Japanese washes the shores of California and must have been a fertile route for navigators between Asia and America.

Similarly the Equatorial current of the Atlantic furnished an easy route between America and Africa.

Lyell well says: "Supposing the human genus were to disappear entirely, with the exception of a single family, placed either upon the Ocean of the New Continent, in Australia, or upon some coral island of the Pacific Ocean, we may be sure that its descendants would, in the course of ages, succeed in invading the whole earth, although they might not have attained a higher degree of civilization than the Esquimaux or the South Sea Islanders."

The human species is now universally

distributed over the globe. It must have had the power of becoming acclimatized and naturalized in every place in which we meet with it. Frenchmen can live and thrive in Corsica, if they avoid the marshes which are fatal to Corsicans themselves. The descendants of English and French in the United States and Canada are not inferior to the first colonists of Europe in America.

Actual statistics show that the increase of French populations in America is in a greater ratio than that of the most favored European populations. French emigrants in the vicinity of the Cape, the Boers, descendants of the Dutch, in the Transvaal, the English in Australia, Europeans in Polynesia and the Irish all over the world have flourished and greatly multiplied.

It is a demonstrated fact that the great Aryan race, originating most probably in the mountain district of Bolor and Hindoo Koh, had the faculty of acclimatization under the most adverse conditions of existence. Its waves of migration have been traced from its centre of appearance to Ceylon on the one hand and Iceland on the other. Finally it gradually distributed its colonies over the whole world. What is true in this respect of the Aryan race is also true of the Negro and Yellow races. In every region of the globe the Black lives side by side with the

White, and Coolies are found in America, Africa and Europe. Gipsies have overrun the whole of Europe, and the Jews are well known to be cosmopolitan.

It is not claimed that any race can become immediately acclimatized in any given locality. Frequently acclimatization follows only after great lapse of time and great losses of individuals. And there are places where no races can live, such as in the estuary of the Gaboon, the Maremma, and the marshes of Corsica. As Quatrefages well remarks: "The conditions of acclimatization vary with the race; that the same climate cannot exercise the same kind of action upon different races, and that complete acclimatization, that is to say, *naturalization*, can only follow upon the harmony of these two terms—race and conditions of life." (The Human Species, page 223.)

Many deny the possibility of the acclimatization of human races, claiming that people simply become accustomed to a given place. Now man in common with all organized beings is subject to all the general laws which govern organized life in animals and plants. It can be easily shown that in animals and plants the phenomena of acclimatization is quite common; that the organization is sometimes modified in its most intimate relations, so as to conform to the exigencies of inflexible conditions of life.

The Chrysanthemum, which is now acclimatized in this country and Europe, came originally from China. It required 60 years of cultivation to acclimatize this flower in France alone.

The Egyptian goose was brought to France by Geoffroy Saint-Hilaire in 1801. This species of fowl lays in December in its native country. For several years the fowl imported into France continued to lay in December and reared its brood in winter. In 1844 the birds laid in February, in 1845 in March, and in 1846 in April, the period at which the common goose lays.

Nearly all the domestic races of animals found in Europe, have been imported into America and are prospering here.

Acclimatization, or physiological adaptation to new conditions of life, is an incontestable fact. In its accomplishment there will be sacrifices proportionate to the differences, as regards conditions of existence, between the two countries, and the loss of individuals and even of generations.

The French have become acclimatized in Algeria after immense sacrifices and the lapse of years of struggles. After still greater sacrifices, Europeans have become acclimatized in Martinique and Guadeloupe.

The Negro race after great struggles has become acclimatized in the English Antilles and in Brazil.

The constant migrations of mankind, assisted by crossings and the actions of climates, have effaced the primitive type of the human species.

We know that atavism in the animal kingdom has often caused the reappearance of ancestral characters. It is thought by anthropologists that some characteristics of our first ancestors ought to appear off and on through the effect of atavism in the human races collectively. A few characteristics that appear at intervals in all the races of man are conjectured to have belonged to the primitive type. Prognathism of the upper jaw, red hair, and yellow skin most probably were characteristics of the original race of man.

We now find mankind divided up into many groups forming distinct races. Let us then consider how these races have originated or sprung from the primitive type. And let us first see how the principal races are distinguished among themselves.

Color has always been regarded as a very distinctive race mark. Dr. Broca has given a graduated scale of race colors, now considered a standard, ranging from the fairest hue of the Swede to the brown-black of the West African.

The kind of hair is another race character. The straight hair of the American and Malay; the wavy hair of the European and kinky or frizzed hair of the Negro are now known to be due to difference in the structure of the hair. The microscope shows straight hair to have circular sections, and wavy and kinky hair to have more or less symmetrically elliptical or oval sections.

Stature is also a mark of race from the tall Patagonian to the dwarfish Fuegian.

The structure of the skull is another important race peculiarity. Skulls are classed: dolichocephalic or long, brachycephalic or broad, and mecocephalic or intermediate. Viewing the skull from above and assuming the diameter from front to back as 100, if the cross diameter from side to side falls below 80, the skull is classed as long; if on the contrary it exceeds 80, the skull is classed as broad; while skulls with a proportionate breadth of 75 to 80 are known as intermediate. This percentage of the skull's breadth to its length is called the cephalic index.

The position of the jaws is also regarded as typical of race. A race is said to be prognathous when the jaws project considerably, and orthognathous when the projection is slight, as in the European.

The celebrated "facial angle" of Camper depends on this distinction.

The capacity of the cranium is also taken as a test of race.

The contour of the face and the general cast of features are looked upon, at least popularly, and correctly too, as typical characteristics of race. The snub nose of the Kerghis, the broad ear of the Kalmuk, the pointed chin of the Arab and the almond eye of the Chinaman are well recognized marks of race.

But these race distinctions are not fixed and permanent, partly because of the mixture and crossing of races and partly because of independent variation of types, or as Blumenbach remarks: "That innumerable varieties of mankind run into one another by insensible degrees." It would be then a hopeless task to attempt to arrange the whole human species within exactly bounded divisions. There are, however, several definite types of mankind that may be taken as standard types. There are several plans of defining such types. Quetelet's method is that of selecting as the standard the most numerous group, on both sides of which the groups decrease in number as they vary in type. It is possible in this way by inspection of considerable numbers of individuals to define the prevalent type of a race with tolerable approximation to the real mean or standard man of the race.

Blumenbach reckons five races or standard divisions: Caucasian, Mongolian, Ethiopian, American and Malay. Cuvier has reduced the divisions to three: Caucasian, Mongol and Negro.

Professor Huxley divides the species into five types: The Australioid, Negroid, Mongoloid, Xanthochroic and Melanochroic.

The Australioids have chocolate skin, black wavy hair, dolichocephalic skull and projecting jaw. The Negroid has brown-black skin, black woolly hair, dolichocephalic skull and projecting jaw. The Mongoloids have yellowish brown skin, black straight hair, brachycephalic skull and oblique eyes. The Xanthochrois have colorless skin, from straw to chestnut colored hair and skull varying in proportions. Melanochrois have olive skin, black hair, skull of varying proportions, light frame and low stature.

The circumstances under which varieties and races among the lower animals and plants originated are well-known. The occurrence of a number of phenomena in man similar to those exhibited by the inferior kingdoms and forming distinct varieties of the same species has been established.

Judging by analogy, we have clearly the right to infer that what was sufficient to occasion a variety among the lower animal species should also be sufficient to produce a variety or race in the human family.

There seem to be two forces acting on the human species as on all organic species, one force constantly tending to maintain the types, which is known as *heredity*, and the other force tending to diversify the typical characters, which may be called the *conditions of life*.

By reason of the force of heredity, the father and mother tend equally to transmit their own character to their offspring. However similar parents may seem to be there is certainly always some difference between them and the nature of the offspring will of necessity be a compromise between two characters. The traits common to both parents will be exaggerated in the offspring, and the different characters will produce a resultant distinct from the two components. Thus in a measure heredity itself is directly the cause of variation. And this force of heredity in producing varieties is greatly aided and influenced by the conditions of life. The conditions of life in the widest sense embrace all the conditions under whose influence a man, animal or plant is formed and grows as germ, embryo, youth and adult. Among the conditions of life affecting the formation of human races are included soil, cold, heat, humidity, dryness, light, food, drink, plenty, penury, morality, human crossings, intellect, mixture of beliefs, customs and manners.

Thus naturalists have shown that monstrosity dates from the earliest stages of the formation of the being and indicates frequently the external causes that have produced it. By the mixing of madder with the food of a female mammal, a red color is produced in the bones of the foetus; and by placing the eggs of a salmon-trout in waters which only nourish white-trout, the eggs become gradually paler and produce trout which have lost the characteristic color of their race.

Thus certain conditions of life strongly affect organism in the embryonic state. But the conditions of life almost equally influence the animal when full-grown. European sheep when transported to the plains of Meta are greatly influenced and changed by the new conditions of life. The fleece is only retained when the sheep are regularly shorn. When left to themselves the wool becomes felty, is detached in flakes and replaced by a short, stiff and shining hair. Thus the same individual sheep under the influence of this burning climate becomes in turn a woolly and a hairy animal.

Heredity and conditions of life give rise to variety. The individual that has deviated from the original type in turn becomes a parent and tends to transmit its exceptional characters to its own offspring. These facts are repeated from offspring to offspring, and at each generation the results of the conditions of life are added to each other. Thus a small deviation at first grows and grows until the change becomes quite marked. Pigs, for example, which have become wild in the Paramos, have acquired a kind of wool under the action of a mild continuous cold.

European oxen gradually lose their hair on the hot plains of Mariquita, and there is a marked contrast between the Guinea and Esquimaux dog.

In short, organisms are modified in order to put them in harmony with the conditions of life. But when once the greatest possible effect has been attained under the new conditions of life, the further action of these conditions can but more fully fix the result obtained and can never produce a change in the opposite direction. The heat that has deprived cattle of their hair can never again restore it, and the cold that has made pigs woolly will never deprive them of the wool.

Thus conditions of life having once produced a race will afterwards cause its permanency and stability.

In the human species the extreme variations seen in domesticated animal species are never found because man in his own case does not make use of selection or cultivation as he does with domestic animals. The limits of variation are then not as extensive in man as in the domestic animals.

But if selection were applied to man himself the result would soon be evident. Thus races really distinguished for their great stature were produced in Prussia and Alsace by marrying the tallest women to the tallest men.

Although the conditions of life do not play as strong a part in the human family as among domesticated animals, yet their action is none the less real. This is strikingly verified in the great western colonies. Every race is represented by derived subraces which vary according to the locality.

North and South America, Australia and the islands of the Gulf of Mexico have their own peculiar derived races, each remarkably characterized.

After twelve generations the Yankee in the United States no longer resembles his ancestors. At the second generation the English Creole in North America, presents in his features, an alteration which approximates him to the native races.

Thus when subject to the action of the conditions of life which have formed the local races, the emigrant races could not help being influenced by it to a great extent, still they will never be confused with the local races or with each other any more than the White transported into Africa would ever become a true Negro, or the European descendants of a Negro ever become true Whites. This is because every race is a resultant whose components are, partly the species itself, and partly the sum of the modifying agents which have produced the deviation from the primitive type.

Every race which is fixed, when brought under the conditions of life which have formed another race, will approximate to the latter; but will partly retain its former impress.

Human races or varieties are formed by heredity and conditions of life. The conditions of life act as the supreme ruler. Heredity, which is essentially a conserving element, becomes an agent of variation, when it transmits and accumulates the modifying actions of the conditions of life.

Man having spread from his centre of appearance into all the parts of the globe, and encountering all manner of climates and all conditions of life, could not have always remained the same. It was utterly impossible that he should retain everywhere and for all time his original characters. The human family was divided up into races, all of which differ from the first model, but all retaining the essential characters that show them to belong to the one only human species.

Chapter XXI.

ANTIQUITY OF MAN.

It is frequently claimed that there is a contradiction between science and Genesis regarding the antiquity of the human family. A thorough sifting of facts will, however, show this claim to be unfounded and the contradiction apparent rather than real.

Genesis does not pretend to give any exact figures for the age of the human race, and science only claims to be able to offer a broad guess at the time of man's first appearance on the earth.

The Sacred Text merely supplies the material for a system of Biblical chronology, but has no established one of its own. Thus the Sacred Books must not be held responsible for the many systems of chronology which various authors have formed upon the basis of data furnished by them.

All records agree that man's first appearance on our globe compared with that of vegetables and animals is indeed quite recent.

The science of chronology is of comparatively recent date. It was a task of very great difficulty with the ancients to determine the length of time intervening between distant historical events even when they had begun to use the astronomical units of measurement. And in still more remote antiquity, when they had to rely for their dates on the enumeration of generations, the difficulty was much enhanced and the result very vague and uncertain. The data afforded by the Bible as the basis of a chronology consist altogether in the numbering of generations. Commentators using this Biblical material were thus led to differ very widely with regard to man's antiquity. Usher's estimate, placing man's age at 4004 B. C. became so popular that it was looked upon for a long time as a classic number similarly to Enke's calculation of ninety-five million for the sun's distance.

It is very well known that ancient authors of all kinds attached but little importance to exactness in the matter of dates. They often put down positively what they knew only by approximation, wishing to give round numbers. It seldom happens that profane historians or even the Scriptures give the halves or any fractions of the year. This gives rise to the supposition that they frequently left years behind unconnected or put down more than they should, and so, in the matter of ancient chronology, it is impossible to arrive at anything like perfect precision.

The Bible has no chronology of its own as already stated, it only gives certain data from which different commentators have formed different chronologies. The age of the human race is nowhere explicitly mentioned in Scripture and even the data furnished by the Sacred Text from which is computed the length of time from man's creation to the Birth of Christ are somewhat obscure and uncertain.

For the sake of convenience, the entire period from Adam to Our Lord is divided into two parts; from the creation of Adam to the Call of Abraham; and from the Call of Abraham to the Birth of Christ. There is very little dispute about the second division, as almost all the chronologies substantially agree in fixing the latter interval at 2000 years.

Different readings of the earliest versions of the Pentateuch, however, have led to widely different computations regarding the length of the former interval. The data for the computation are derived from the two genealogical lists of the patriarchs from Adam to Noe and from Noe to Abraham. In Genesis (Vulgate) (v. 3–32) we read: "And Adam lived a hundred and thirty years, and begot a son to his own image and likeness, and called his name Seth.

Seth also lived a hundred and five years and begot Enos.

And Enos lived ninety years, and begot Cainan.

And Cainan lived seventy years, and begot Malaleel.

And Malaleel lived sixty-five years, and begot Jared.

And Jared lived a hundred and sixty-two years, and begot Henoch.

And Henoch lived sixty-five years, and begot Mathusala.

And Mathusala lived a hundred and eighty-seven years, and begot Lamech.

And Lamech lived a hundred and eighty-two years, and begot a son. And he called his name Noe.

And Noe, when he was five hundred years old, begot Sem, Cham and Japheth.

And in Genesis (Vulgate) (xi. 10–26): "These are the generations of Sem: Sem was a hundred years old when he begot Arphaxad, two years after the flood.

And Arphaxad lived thirty-five years, and begot Sale.

Sale also lived thirty years, and begot Heber.

And Heber lived thirty-four years, and begot Phaleg.

Phaleg also lived thirty years, and begot Reu.

And Reu lived thirty-two years, and begot Sarug.

And Sarug lived thirty years, and begot Nachor.

And Nachor lived nine and twenty years, and begot Thare.

And Thare lived seventy years, and begot Abram, and Nachor, and Aran."

Here we have the age of each individual member of the genealogy at the time when the next in succession was born. Thus we find that from Adam's creation to the birth of Seth a hundred and thirty years intervened and from the birth of Seth to that of Enos a hundred and five years and so on.

Adding seventy-five years to the time computed through these genealogies from the creation of Adam to the birth of Abraham, we have the whole time to Abraham's Call; because Genesis (xii. 4) says that

"Abraham was seventy and five years old when he went forth from Haran."

The three earliest versions of the Pentateuch are the Hebrew, the Samaritan and the Septuagint, and each one of them widely differs from the others in its estimate of the age of the human family. Between the estimate made from the Septuagint and the Hebrew, there is a discrepancy of about 1500 years.

Many reasons are given for the discrepancies between the figures found in the three versions. Some are supposed to be due to copyists and others to design. But no explanation yet suggested is entirely satisfactory. Many copyists had disciples who greatly revered them and so finding their notes and figures in the margins, when recopying, placed them through reverence in the body of the text.

It is well known that when a long list of names and numbers are copied and recopied thousands of times from age to age, errors are certain to creep in and be perpetuated.

It is now impossible to decide which of the versions has the best claim to our acceptance. Each of them has powerful apologists and redoubtable champions, the weight of most eminent authority would seem, however, to favor the figures of the Septuagint.

The Church herself pronounces nothing

upon the subject, leaving it freely open to the arguments of theologians and commentators,—the precise antiquity of the human race not being considered a matter of faith.

These different computations based on the versions of the Pentateuch, place the age of the human family between four and six thousand years from the creation of man to the Birth of Christ. Adding to this estimate the sum of 1898 years, the computation of man's age according to Biblical material would be between six and eight thousand years.

GENEALOGICAL TABLE OF GENESIS.

Patriarchs.	Age of Each When Son Was Born According to		
	Samaritan Text.	Hebrew Text.	Septuagint Text.
Adam	130	130	230
Seth	105	105	205
Enos	90	90	190
Cainan	70	70	170
Malaleel	65	65	165
Jared	62	162	162
Henoch	65	65	165
Mathusala	67	187	167
Lamech	53	182	188
Noe	500	500	500
Sem (to Birth of Arphaxad two years after the Deluge.)	100	100	100
	1307	1656	2242
Arphaxad	35	35	135
Cainan	.....	.....	130
Sale	130	30	130
Heber	134	34	134
Phaleg	130	30	130
Reu	132	32	132
Sarug	130	30	130
Nachor	79	29	79
Thare	70	70	70
Abraham's Call	75	75	75
Total from Creation of Adam to Abraham's	1015	365	1145
Vocation	2322	2021	3387

St. Jerome, St. Augustine and St. Thomas were of the opinion that no exact length of time for man's age on the earth could be gathered from Biblical sources.

St. Paul himself recognized the difficulties surrounding scriptural chronology when he gave this counsel: "Not to give heed to fables, and endless genealogies, which furnish questions rather than the edification of God."

And the gravest, most learned and most reputable authors claim that chronological uncertainty attaches to all ancient history as well sacred as profane. Calmet, Julius Africanus, Isaac Vossius and M. Simon were of this opinion.

Pagi likewise admits the uncertainty of chronological accuracy, as do also Molloy, Brucker and Bishop Meignan, all declaring that some generations may have been omitted by the copyist and some by the sacred writer.

In Josephus, the years of the Judges and the periods of servitude that happened in their time are not continuous and immediately consecutive, having been interrupted by anarchies which preceded the servitudes of the Israelites.

The periods of the captivities and anarchies are omitted in the Sacred Text, being looked upon as dead spaces.

It would seem very certain that in the Sacred Scriptures the genealogies are not always immediately consecutive. A retrenchment of this kind occurs in 1 Esdras (vii. 3) where six generations are entirely omitted, and in St. Mathew six persons are wanting to the genealogy of Our Lord.*

Prichard, in his "Researches into the Physical History of Mankind" (vol. v.) says: "It is obvious that all these sets of dates except one must be wrong; and we may consider it as almost certain that the discrepancies have been introduced by mistake, and that the original expressions denoting numbers were not understood. This can be imagined on one hypothesis, viz: That the most ancient copies of Genesis, or at least of these particular documents, contained in the several sections, not the sums of years expressed in words, but some numerical marks, the real force of which had been lost in the lapse of time, and through various accidents, and that attempts were made at later but different times, and by various persons, to convert the numbers marked down by numerical signs into words. . . . It may be supposed that the scribes who originally translated numerical

* There are also slight genealogical omissions in the tables of Ruth, I and II Paralipomenon, Mathew and Luke, the Pentateuch and 3rd and 4th Kings.

signs into numbers expressed by words in the tables of Patriarchs, adopted some erroneous principle of interpretation, which greatly augmented the numbers originally denoted by those signs."

Concerning the difficulties of forming an exact Chronology, Calmet remarks as follows: "Some nations have made their years of one month, others of four, others of six. Some have made one year of the summer and another of the winter; some have made their year of ten months, others of twelve. Historians, and we may say the same of transcribers and translators, have often confounded all these years, and without remarking the difference of the years of the nations they were speaking of from those in usage in their own country, they have fixed the times by equivocal marks, and thus introduced confusion into chronology and history."

Lenormant says in his Ancient History (page 122): "We are convinced that religious truth is far from being tied to questions of literature or of chronology. Christian faith no more reposes upon the chronology of Genesis, than upon its physics and its astronomy."

And there are many eminent orthodox commentators of this same opinion of Lenormant, that inspiration does not extend to matters not essentially or influentially connected with religious truth, and so claim that some of these chronological inaccuracies originated with the sacred authors themselves. There really seems to be no means left for ascertaining the real age of man in the world. The ancient Hebrews seemed to be of this same opinion, since the Scriptural writers have always avoided any attempt to compute it.

Thus the Old Testament really contains no reliable material upon which a thoroughly accurate chronology of man's age can be established. Genealogical lists of generation after generation have been passed by without mention. The lapses have been detected from other parts of the record. It may be fairly supposed that other omissions have occurred which commentators have been unable to detect, particularly in the earlier aud more meagre portions of Holy Writ.

These lapses may have been very great for all we know to the contrary. Chronologists have always confessed to a great confusion in the numbers given in the Sacred Books. It would seem under the circumstances that from Biblical data we can safely place man's age upon the planet at from eight to ten thousand years.

Chapter XXII.

ANTIQUITY OF MAN. (Con.)

Science suggests, rather than offers a means of calculating, a higher antiquity for man than is allowed by Biblical chronologists. Leaving out of the question zealots and charlatans, reputable scientists claim for man's antiquity all the way from ten thousand to one hundred thousand years. Le Conte in his Geology (page 390) says: "The amount of time which has elapsed since man first appeared is still doubtful. Some estimate it at more than a hundred thousand years—some only ten thousand."

The claims of science for man's great age are founded on the finding of suspected fossils of the human species in the deposits of the Quaternary Period, particularly the Champlain epoch, in company with the bones of the Rhinoceros, the old Elephant, the Cave Hyena, the Cave Bear and other extinct species of animals; from ancient monuments; Hieroglyfics; Lake-Dwellings; and Archæology.

It is practically acknowledged by geologists universally that there is no satisfactory evidence of man's existence previous to the Champlain epoch. The Quaternary Period is divided into the Glacial, Champlain and

Terrace Epochs. The Quaternary Period in Geology immediately succeeds the Tertiary and is the last preceding and preparatory to the present Period.

The whole history of the Earth geologically is divided into five great eras: The Eozoic, Palæozoic, Mesozoic, Cenozoic and Psychozoic, each having its own rock system.

The Eras are subdivided into Periods and the Periods into Epochs.

The Cenozoic era and Mammalian age is divided into two periods—the Tertiary and Quaternary.

Of all the periods the Quaternary has been most remarkable for the wide-spread great up and down or vertical movements and convulsions of the earth's crust in the higher latitudes, north and south. Its striking characteristic was great changes in climate and species. Mammals culminated in this Period, it was the great Mammalian age.

The Glacial Period was marked by an upward movement of land in high latitudes to a height of 1000 or 2000 feet above the present level, followed by vigorous cold.

The Champlain epoch was noted for a sinking down of the region raised in the Glacial epoch to a depth of from 500 to 1000 feet. Owing to a moderation of temperature and a melting of ice, it became a flooded epoch, when loosened icebergs floated over the flooded seas.

The Terrace epoch was one of upheavals when the earth's crust was raised to its present level. Probably the most marked effects of the land sinking process during the Champlain Period are witnessed on the shores of Lake Champlain, where evidences are found of the regions in the neighborhood of the Lake having been raised since that period from 400 to 500 feet.

At this height above the waters of the Lake have been found marine shells and the skeleton of a whale. Hence the Lake has given its name to the Period.

A small number of human skeletons have been found in Europe, which have been claimed by scientists to belong to Quaternary man of the Champlain Period. All anthropologists agree that human remains have been found in surprisingly small numbers.

The most famous human skeleton and one of the oldest ever found, is that of Mentone. It was discovered by M. Rivière in a cave at Mentone, just east of Nice, and is now in the Anthropological Gallery of the Paris Museum. The skeleton is that of an old man, six feet high, with a long large head, high and well formed forehead and a quite large facial (85°) angle. The skeleton when found was in a nearly perfect state, lying on its side in an easy position seemingly, surrounded by shells, chipped implements, pierced reindeer's teeth and bones of extinct animals. A crust of stalagmite covered the whole and preserved them all perfectly.

Another remarkable skeleton, closely resembling the one of Mentone, is that obtained from the Cave of Cro-Magnon, in Perigord, France. This skeleton is five feet eleven inches in height. In 1867, M. Emile Martin discovered the skeleton of a man, five feet ten inches in height, in gravel pits opened at Grenelle in the neighborhood of Paris.

Schmerling, in 1833, discovered near Liege, Belgium, remains of a smaller and less perfect race of men.

Other portions of human skeletons were discovered at Canstadt, Düsseldorf, in the caves of Furfooz in Belgium and La Fruchère. These men whose remains have been discovered strongly resemble the men of the present day, all having had a fair average human skull and of good Caucasian type. Anthropologists generally refer these races to Champlain times.

Besides these skeletons many relics of antique races, such as implements, utensils, ornaments in company with the bones of extinct animals have been found. This subject of "Finds" belongs to the province of Archæology, and archæologists have divided human history into three ages, the Stone, Bronze and Iron ages.

They subdivided the stone age into the Palæolithic and Neolithic, the older and newer stone age. The older stone age is placed contemporary with the Champlain Period.

As the Finds of the older stone are the most ancient traces of man it is only necessary to consider them in the search for the probable time of the first appearance on earth of our species. The Finds of the Palæolithic stone age are classed under the heads of chipped flints, arrow heads and various stone implements of the almond-shaped type; pointed flints wrought on one side, of the Moustier type; thin and narrow tongue-shaped flakes or knives, having one of the ends chipped to a point and used as scrapers; fossil shells of globular form pierced through the middle and thought to have been used as ornaments.

The chief places in which these articles have been discovered are the caves and grottoes of Murignac, Vergisson, Sainte-Reine, Arcy, Vallières, La Chaise, Moustier, Ariege, in France; Brixham, Gower, Kirkdale and Wells, in England; Chiampo, Lagilio, Palermo, San Ciro and Macagnone, in Italy and Sicily; Liege, Engihoul, Engis and Naulette, in Belgium.

It is almost impossible to guard against fraud in these Finds. The natural color of these worked flints belonging to the earliest epoch of man's existence is white on one side and brown on the other. These Finds may all be referred back to the Champlain Period.

Lake Dwellings are collections of houses with low sloping roofs perched on lofty piles sunk deeply in lake bottoms near the shores, and connected with each other by bridges of planks. The houses seem to be all constructed on the same plan and consist of two apartments; the split stems of trees covered with mats form the floor. The houses are reached from the shore by means of rude canoes. From the canoes the ascent is made into the houses by means of ladders made of notched tree trunks.

Villages of such dwellings are common in the Gulf of Maracaibo, in the estuaries of the Amazon and Orinoco, in New Guinea, Lake Mohrya, in Central Africa, in Borneo, Celebes, Caroline Islands and many other places.

These dwellings are a safe protection

against great inundations and a sudden attack of an enemy.

Archæological researches have unearthed the ruins of numbers of pre-historic lake dwellings. Switzerland furnishes the greatest number of these pre-historic finds. Relics of the Lake Dwellers have been discovered in almost every lake in Switzerland, in lakes Zurich, Constance, Geneva, Bienne, Neufchâtel, Morat, Moosseedorf and several others.

Vast quantities of implements of horn, bone, stone, bronze and pottery have been found among the ruins, together with a few of gold, wood and iron. The bones of extinct animals have been discovered mingled with the other relics and in a very few cases portions of the human skeleton.

Remains of Lake Dwellings under the name of Crannoges have been found in Ireland and Scotland.

Various estimates of the age of these lake-dwellings have been attempted but they are so largely the result of conjecture, that they have little scientific value, if indeed any at all. The oldest lake dwellings are thought to be those of Lake Moosseedorf, near Bern, and the most recent, those of Ireland.

The implements found in these ruins of Moosseedorf are ax-heads of stone, a flint saw with fir-wood handle, flint flakes and arrow heads; harpoons of stag's horn, awls, needles, chisels, fish-hooks of bone, a comb of yew wood; roughly made vessels of pottery, evidently used in cooking; wheat, barley, linseed,—several varieties of seeds and fruits; bones of the stag, the ox, the swine, the sheep and the goat; relics of the beaver, the fox, the hare, the dog, the boar, the horse, the elk and the bison.

When Lake Lagore, near Dunshaughlin, Ireland, was drained in 1839, what appeared as an island was discovered to be a crannoge from which 150 cart loads of bones were taken. The bones of horses, asses, deer, sheep, goats, dogs and foxes, and numbers of ornaments, weapons, utensils of wood, bone, stone, bronze and iron were mingled together.

The structure consisted of oak piles mortised together and laid on the bottom of the lake, and strengthened with cross beams.

The ancient annals of Ireland relate that this island was burned by a hostile chief in 848 and the dwellings plundered and pulled down by Norse pirates in 933.

Ancient monuments, such as Cairns, Cromlechs, Sepulchral Mounds, Pillars, Obelisks, Pyramids, Archs, Brasses, Tombs, Stufas and Mausoleums are often pointed to as evidences of man's high antiquity. Le Conte, in his Geology (page 24) says that:

"On the flood-plain of the Nile stand the oldest monuments of civilization in the world." The statue of Rameses II, which has been covered about the base with sediment nine feet deep he calculates to be 3,000 years old.

Concerning the length of time that elapsed since the beginning of the stone age, there can be but the merest and most unreliable conjectures. The three conditions of man represented by the stone, bronze and iron ages have always co-existed side by side upon the earth. There has always been the highest civilization and the lowest barbarism.

In many countries the three ages have existed together and in others they slowly graduated one into the other without the preceding ones disappearing. In Polynesia, Central and Southern Africa, America—except Peru and Mexico, the people moved directly from the Stone to the Iron age without passing through the Bronze.

When America was discovered, the native tribes were still in the stone age. So that it would be the sheerest folly to undertake to give any figures for man's antiquity taken from these ages.

Many contend that the bones of extinct animals found mingled with the implements of the stone age point to a high antiquity.

The animals living in the early stone age and since extinct, were the hairy mammoth, woolly rhinoceros and the hippopotamus. For all that is known to the contrary these animals may have become extinct very suddenly or by slow degrees after long ages. There is no certainty in the matter and so no criterion to accurately judge by.

The Moa (Dinormis) of New Zealand, the Dodo and Solitaire of the Mauritius in the Indian Ocean, the Æpyornis of Madagascar, and other species have become extinct in very recent times and very suddenly. The Rytina of Siberia became extinct in the last century and the great Auk of the North Sea were last seen in 1844.

It is well known that the American Buffalo is rapidly passing away before our eyes.

The extermination of animal species afford then no data for reliable figures.

The finding of human skeletons furnishes no data more reliable. In the first place their number is so extraordinarily small that nothing can be generalized from them.

In the cataclysms and inundations always so frequent, they may have been washed into the caves wherein they have been found and mingled with bones of the older animal species. That they were encrusted with stalagmite, adds nothing, as this process is sometimes slow and sometimes rapid. Thus for instance, Lyell thinks that the famous skeleton found in 1857 in the Neanderthal Cave, near Düsseldorf, may have been washed in.

The few remains of ancient human races unearthed have been mostly confined to a small radius in Europe.

The human finds in America have mostly proven hoaxes upon close examination. The human footprints found in a rock near St. Louis were simply Indian carvings. The human skeletons discovered in the neighborhood of Guadalupe were proven to be of bodies buried but a few hundred years ago and afterwards petrified. The Find of Natchez and the fossil man of Florida were the baldest impositions. The Table Mountain and Calaveras skulls made a great stir among antiquarians for a short time. Professor Whitney, as late as 1879, claimed the Calaveras county cranium to be a genuine relic of Quaternary man.

But the miner that perpetrated the joke at last confessed. A miner named Mattison produced the Calaveras skull in 1866; dug it out, he said, in his mine, 130 feet below the surface, from beneath the lava which had flowed from a volcano in the pliocene period.

The lava where the skull was ostensibly found had flowed out over that country eons before the basaltic cap-covered Table Mountain itself had existed. The skull was coated with a deposit of gravel and sand that told of its lying at one time in a river-bed. The skull was broken in the strongest part, an evidence of the strength of the mighty torrent that had dashed it against the bowlders.

A bored shell was found near by, supposably used as an ornament. At some time during the skull's wanderings, in the river's bed, or resting on its bank, a snail had crawled under the malar bone and died there. They found its shell there, and no such snail has lived since the volcanoes ceased pouring lava over California.

The humor occasioned by these finds in mining districts is well expressed by Bret Harte in the following little poem:

THE SOCIETY UPON THE STANISLAUS.

I reside at Table Mountain, and my name is Truthful James;
I am not up to small deceit, or any sinful games;
And I'll tell in simple language what I know about the row
That broke up our society upon the Stanislaus.

But first I would remark, that it is not a proper plan
For any scientific gent to whale his fellow man;
And, if a member don't agree with his peculiar whim,
To lay for that same member for to "put a head" on him.

Now nothing could be finer or more beautiful to see,
Than the first six months' proceedings of that same society,
Till Brown of Calaveras brought a lot of fossil bones
That he found within a tunnel near the tenement of Jones.

Then Brown he read a paper and he reconstructed there,
From those same bones, an animal that was extremely rare;

And Jones then asked the Chair for a suspension of the rules,
Till he could prove that those same bones was one of his lost mules.

Then Brown he smiled a bitter smile, and said he was at fault,
It seemed he had been trespassing on Jones' family vault;
He was a most sarcastic man, this quiet Mr. Brown,
And on several occasions he had cleaned out the town.

Now I hold it is not decent for a scientific gent
To say another is an ass,—at least to all intent;
Nor should the individual who happens to be meant
Reply by heaving rocks at him to any great extent.

Then Abner Dean of Angel's raised a point of order—when
A chunk of old red sand stone took him in the abdomen,
And he smiled a kind of sickly smile, and curled up on the floor,
And the subsequent proceedings interested him no more.

For, in less time than I write it, every member did engage
In a warfare with the remnants of a palæozoic age;
And the way they heaved those fossils in their anger was a sin,
Till the skull of an old mammoth caved the head of Thompson in.

And this is all I have to say of these improper games,
For I live at Table Mountain, and my name is Truthful James;
And I've told in simple language what I know about the row
That broke up our Society upon the Stanislaus.

One remarkable feature connected with the Finds everywhere is that the skeletons of the supposed pre-historic man show him to be of as perfect races as those of to-day. On this subject America's greatest geologist, Dana, says: "In the case of Man, the abruptness of transition is still more extraordinary, and especially because it occurs so near to the present time. In the highest Man-ape, the nearest allied of living species has the capacity of the cranium but thirty-four cubic inches; while the skeleton throughout is not fitted for an erect position, and the fore-limbs are essential to locomotion: but, in the lowest of existing men, the capacity of the cranium is sixty-eight cubic inches, every bone is made and adjusted for the erect position, and the fore-limbs, instead of being required in locomotion, are wholly taken from the ground, and have other higher uses. Forty years since, Schmerling found fossil bones of ancient Man in Europe; and for the past fifteen years active search has gone forward for the missing links; and still the lowest yet found,—and this probably not the oldest,—has a cranium of seventy-five cubic inches capacity. Some of the oldest yet discovered have a large cranium and a high facial angle, although rude in implements and mode of life. No remains bear evidence to less perfect erectness of structure than in civilized man, or to any nearer approach to the Man-ape in essential characteristics.

The existing Man-apes belong to lines that reached up to them as their ultimatum; but, of that line which is supposed to have reached upward to Man, not the first link below the lowest level of existing Man has yet been found. This is the more extraordinary, in view of the fact that, from the lowest limit in existing men, there are all possible gradations up to the highest; while, below that limit, there is an abrupt fall to the ape level, in which the cubic capacity of the brain is one half less. If the links ever existed, their annihilation without a relic is so extremely improbable that it may be pronounced impossible. Until some are found, Science cannot assert that they ever existed." (Geology, page 603.)

Chapter XXIII.

THE DELUGE.

There is scarcely any considerable race of men among whom there does not exist, in some form, the tradition of a great deluge, which destroyed all the human family except a favored few of their own progenitors.

Humboldt, the great traveler and naturalist, found this tradition general and still fresh among the tribes of the Orinoco. Herrera, the Spanish historian, relates that it is common among the Brazilians, the Peruvians, the Mechoachans and Cubans.

The inhabitants of Tahiti, the Indians of Terra Firma and of the North American lakes held this tradition distinctly. The sacred records of the Parsees (doubtful), the Mohammedans and the Scandinavians contain traditions of the great flood. The Chinese, Hindoos and the peoples of the isles of the Pacific also have similar traditions.

The Chaldean tradition of the deluge as related by Berosus and quoted by Josephus is strikingly similar to the Mosaic account.

The Assyrian records and Grecian mythologies mention the great cataclysm.

Catlin says that among 120 different tribes in North, South and Central America visited by him, not a single one exists that did not narrate to him a story of this great calamity to the infant race. The Egyptians alone (except probably in their hieroglyfics) seem to have no flood legend and its existence is extremely vague among the Persians and the pagan portions of Africa. Otherwise the tradition may be said to be absolutely universal among all the peoples of the earth, each giving a local coloring.

Of all the great misfortunes of the infancy of our race, this seems to have been the deepest and direst. It impressed the minds of the few survivors with such terror that its memory has survived all the vicissitudes of time.

Many of the nations have preserved this tradition by means of pictures and hieroglyphics. The old coins of classical Greece, the hieroglyphics of Egypt (probably), the sculptures of Hindustan, the picture-writings of old Mexico and the recently discovered Chaldean Cuneiform Inscriptions have all preserved symbolically the great tradition.

The learned commentators of the Mosaic narrative of the flood put forth two opinions principally concerning its territorial extent.

Some contend that it was absolutely universal over the whole globe, and others, and now the more numerous, claim that while it was universal as to mankind, it was only partial as to the earth.

This question as to whether the deluge was universal or partial is entirely a problem of physics and is no more moral in its bearing, than the questions that refer to the right figure or correct age of our planet or the true motions of the heavenly bodies. God designed to punish mankind for the sins of the race. His object was to destroy man, and his purpose could certainly be sufficiently accomplished whether he did it by a partial or an universal flood.

Against the absolute universality of the deluge as regards the whole globe, the following arguments are urged: Genesis gives very precisely the form and dimensions of Noah's Ark. It was the shape of an oblong box, three stories high, with a roof of the ordinary angular form. The Ark measured three hundred cubits in length, fifty cubits in breadth, and thirty cubits in height. Could all the animals in the world, by sevens and by pairs, with sufficient food to serve them for a twelvemonth, be accommodated within this given space?

Sir Walter Raleigh, who was an experienced navigator, and a thoroughly competent judge in such matters declared that in a vessel of the dimensions of Noah's Ark there would be ample room for eighty-nine distinct species of beasts, or, lest any should be omitted, for a hundred several kinds, and for the birds, and for meat to sustain them all. All the beasts might be kept in one story or room of the Ark, in their several cabins; their meat in a second; the birds and their provision in a third, with space to spare for Noah and his family, and all their necessaries.

In Sir Walter Raleigh's time, the known animals of the world embraced only eighty-nine species. But since his time the increase in discovered new species has been truly prodigious. A single centre of creation as known to zoölogists to-day would embrace much more than these eighty-nine species. In Buffon's time, Raleigh's estimate of the number of species had to be doubled owing to new discoveries. Because of late discoveries of new species of animals in America and Australia more particularly, and also in other parts of the world, the number of distinct species now known and classified for the whole globe would reach 700,000.

To get sevens and pairs of all these into a vessel of the dimensions of Noah's Ark, together with food sufficient for a twelvemonth, to transport them to the Ark over oceans and impassable barriers of other kinds, and return them back again, after the waters subsided, to their own countries, would require miracles upon miracles, it is alleged. It seems to be after God's methods never to multiply miracles unnecessarily, one of his attributes being immutability. On this subject Chalmers well says: "It is remarkable that God is sparing of miracles, and seems to prefer the ordinary processes of nature, if equally effectual for the accomplishment of his purposes. He might have saved Noah and his family by miracles; but He is not prodigal of these, and so He appointed that an Ark should be made to bear up the living cargo which was to be kept alive on the surface of the waters; and not only so, but He respects the laws of the animal physiology, as He did those of hydrostatics, in that He put them by pairs into the Ark, male and female, to secure their transmission to after ages, and food was stored up to sustain them during their long confinement. In short, He dispenses with miracles when these are not requisite for the fulfillment of his ends; and He never dispenses with the ordinary means when these are fitted, and at the same time sufficient, for the occasion." (Daily Scripture Readings, vol. I., p. 10.)

Another difficulty is this. It is well known to geologists that every great continent has its own peculiar fauna; that the original centers of animal creation must have been many, and that the neighborhood of these centers must have been occupied by their pristine animals in ages long anterior to that of the Noachian Deluge, and that in the later geological ages they were preceded in them by animals of the same general type. "The great continents," says Cuvier, "contain species peculiar to each; insomuch that whenever large countries of this description have been discovered, which their situation had kept isolated from the rest of the world, the class of quadrupeds which they contained has been found extremely different from any that had existed elsewhere. Thus, when the Spaniards first penetrated into South America, they did not find a single species of quadruped the same as any of Europe, Asia, or Africa. The puma, the jaguar, the tapir, the cabiai, the lama, the vicuna, the sloths, the armadilloes, the opossums, and the whole tribe of sapajous, were to them entirely new animals, of which they had no idea. Similar circumstances have occurred in our own time, when the coasts of New Holland and the adjacent islands were first explored. The various species of kangaroo, phascolomys, dasyurus, and perameles, the flying phalangers, the ornithorynchi, and echidnæ, have astonished naturalists by the strangeness of their conformations, which presented proportions contrary to all former rules, and were incapable of being arranged under any of the systems then in use." And Walworth (The Gentle Skeptic, page 305) says: "But further—and this seems to make the case conclusive against an universal deluge—it is evident that the same districts or provinces have been occupied by animals of the same general type as now at very remote periods of the world's history—periods which are represented by the extinct species of the fossil world. The sloths and armadilloes peculiar to South America, the kangaroos of Australia, and the wingless birds of New Zealand tread upon the very soil beneath which kindred but fossil forms of life lie sepulchred. It is a settled fact then, that during long periods of time, reaching far beyond all human history, creatures of one species have succeeded to other species of the same or a similar type within the same areas. The conclusion against any universal deluge is evident, the argument being briefly this: Geology in concert with Zoölogy, shows that at periods long anterior to any supposable date of the Deluge, the distribution of land animals upon the earth was much the same as now. But, if the groups of the antediluvian world have been all broken up by an overwhelming and destroying flood, it is unaccountable that the ancient districts should each have reclaimed anew its own peculiar fauna."

Darwin (Origin of the Species, page 295) remarks as follows: "Mr. Clift, many years ago, showed that the fossil mammals from the Australian caves were closely allied to the living marsupials of that continent. In South America a similar relationship is manifest, even to an uneducated eye, in the gigantic pieces of armor, like those of the armadillo, found in several parts of La Plata; and Professor Owen has shown, in the most striking manner, that most of the fossil mammals buried there in such numbers, are related to South American types. The relationship is even more clearly seen in the wonderful collection of fossil bones made by MM. Lund and Clausen in the caves of Brazil. I was so much impressed with these facts, that I strongly insisted in 1839 and 1845 on this 'law of the succession of types'—on 'this wonderful relationship between the dead and the living.' Professor Owen has subsequently extended the same generalization to the mammals of the Old World. We see the same law in this author's restoration of the extinct and gigantic birds of New Zealand. We see it also in the birds of the caves of Brazil. Mr. Woodward has shown that the same law holds good with sea shells."

Again, without a special miracle, at the lowest calculation three-fourths of the vegetation of the earth would have perished in a universal deluge that covered over the dry land for the space of a year. The very best botanists declare that the various vegetable regions bear witness to no such catastrophe. Either no effacing flood has passed over these regions or they were shielded from its destroying effects at the cost of miracle upon miracle, for they are still distinct and unbroken as of old.

Again, in many parts of the world, as for instance Auvergne in France, and on the sides of Mount Ætna, there are cones of extinct or long-slumbering volcanoes, which, although more than three times the antiquity of the great flood, exhibit not the slightest marks of its denuding action. It is well known that the cones of volcanic craters are composed of loose incoherent scoriæ and ashes, which, when exposed to the action of waves and currents, are completely swept away in a very short time. As a striking example of the action of currents upon volcanic cones, we may cite what happened to Graham's Island, which rose out of the sea in July, 1831.

In the succeeding August, this volcanic island had acquired a circumference of three miles and reached to a height of two hundred feet. In less than four months, the sea had washed it completely away, leaving only a shoal to mark the place where it once existed.

The volcanic islands of Nyve and Sabrina were also carried away by oceanic currents in a few months after their sudden formation.

Lyell has estimated that no great flood could have possibly touched the volcanic cones on the flanks of Ætna for the past twelve thousand years. Neither has any great flood passed over the crater cones of Auvergne for even a greater antiquity, since these cones are older than those of Ætna, as old, indeed, as the times of the Miocene. The crater cones on the sides of both these volcanoes retain in entire integrity their original shapes. Now certainly if the Ætna and Auvergne districts had been within the area of the Deluge, it is claimed that the loose scoriæ of their conic craters would have been completely washed away during the seven and one-half months that the waters had submerged the great mountain tops.

The majority of the most learned commentators of the present time claim that the language of Moses relating to the great flood should be taken figuratively, rather than literally. The figure or trope of synecdoche is certainly frequently used in the Bible. Indeed this trope is one of the beauties of every literature.

The Bible says that "all the high hills which were under the whole heavens were covered." But the facts of astronomy, geology, and natural history seem to be irreconcilable with the supposition of a universal deluge, unless it be accompanied with the supposition of a series of the most stupendous miracles. Accordingly it is the opinion of the best Biblical critics of to-day, such as Nägelsbach, Edward Hitchcock, Taylor Lewis, J. J. S. Perowne, Dr. Strong and others that the human race at the time of the deluge occupied but a small portion of the earth's surface, lying mostly in the basin of the Euphrates and Tigris, that the deluge was confined to that region and that the Scriptural expression above quoted is to be taken in a limited signification.

God intended to destroy the human race in punishment of sin. God had certainly no motive in destroying the animal and vegetable kingdoms, for they had not incurred his displeasure. God being immutable, works only the miracles absolutely necessary to carry out his purpose. He is naturally adverse to working superfluous miracles. God could have fulfilled his purpose in destroying the human species in its early infancy, when confined within narrow limits, without submerging the whole earth.

The practice of putting the whole for a part has been quite common with the sacred writers. Thus, on the day of Pentecost the Bible says that Jews assembled at Jerusalem "*out of every nation under heaven*;" again "that the Gospel was preached to *every creature under heaven*;" also that the Queen of Sheba came to hear Solomon from "the uttermost parts of the earth;" that God put the dread of the Israelites upon the nations that were "*under the whole heavens*;" and "that all countries came into Egypt to Joseph to buy corn."

Any one of these passages point as strongly to universality as do those which refer to the flood which say that the "waters prevailed exceedingly on the earth," so that "all the high hills that were under the whole heavens were covered,' or that 'all flesh died that moved upon the earth."

The Scriptures themselves sometimes define the limits of the metonymic passage. This happens for instance in the case of the assemblage of Jews on the day of Pentecost. The Scripture mentions the countries from which these Jews had come. They came really only from those countries in the neighborhood of Judea, as far as Italy on one side and the Persian Gulf on the other, an area not equal to one-fiftieth of the whole earth.

Many of the passages are not explained and defined by Scripture. For the proper interpretation of the latter passages help must be sought from ancient history and geography.

In determining the extent of the "all" in the passage connected with the Queen of Sheba and "all the world" taxed by Augustus, we must find out how much of the world had been discovered in Solomon's time and the extent of the Roman Empire in that of Cæsar.

So that passages of the scriptures involving questions of physical sciences must be in a great measure interpreted according to the discoveries of these sciences. Very distinguished theologians as well as scientists have held that the Noachian deluge was only partial. Poole says: "It is not to be supposed that the entire globe of the earth was covered with water; where was the need of overwhelming those regions in which there were no human beings?"

Stillingfleet says: "The Flood was universal as to mankind; but from thence follows no necessity at all of asserting the universality of it as to the globe of the earth, unless it be sufficiently proved that the whole earth was peopled before the Flood, which I despair of ever seeing proved."

Dr. Pye Smith, Professor Hitchcock and other eminent scientists, as already stated, held the theory of a partial deluge.

Even though the Deluge was a partial one, to Noah and his family in the Ark it would appear universal, for they would see only ocean extending from horizon to horizon and all the hills and mountains they knew would disappear beneath the waves.

The true question, however, it may be remarked, concerning the universality or non-universality of the Flood is not whether or no Moses is to be believed in the matter, but whether or no we in reality understand Moses.

Hugh Miller, "Little Red Sandstone," is a strong advocate of a deluge partial as to extent, but universal as to mankind, and gives his opinion in this forcible manner:

"The question is, whether we are to regard the passages in which he (Moses) describes the Flood as universal, as belonging to the very numerous metonymic texts of Scripture in which a part—sometimes a not very large part—is described as the whole, or to regard them as strictly and severely literal. Or, in other words, whether we are, with learned and solid divines of the olden time, such as Poole and Stillingfleet, and with many ingenious and accomplished divines of the passing age, such as the late Dr. Pye Smith and the Rev. Professor Hitchcock, to regard these passages as merely metonymic; or, with Drs. Hamilton and Kitto, to regard them as strictly literal, and to call up in support of the literal reading an amount of supposititious miracle, compared with which all the recorded miracles of the Old and New Testaments sink into insignificance. The controversy does not lie between Moses and the naturalists, but between the *readings* of theologians such as Mathew Poole and Stillingfleet on the one hand, and the *readings* of theologians such as Drs. Hamilton and Kitto on the other. And finding all natural science arrayed against the conclusions of the one class, and in favor of those of the other, and believing further, that there has been always such a marked economy shown in the exercise of miraculous powers, that there has never been more of miracle employed in any one of the dispensations than was needed, I must hold that the theologians who believe that the Deluge was but co-extensive with the moral purpose which it served are more in the right, and may be more safely followed, than the theologians who hold that it extended greatly further than was necessary. It is not with Moses or the truth of revelation that our controversy lies, but with the opponents of Stillingfleet and of Poole." (Testimony of the Rocks, page 308.)

Miller ventures the following theory of the great cataclysm: "There is a remarkable portion of the globe, chiefly in the Asiatic continent, though it extends into Europe, and which is nearly equal to all Europe in area, whose rivers (some of them, such as the Volga, the Oural, the Sihon, the Kour, and the Amoo, of great size) do not fall into the ocean, or into any of the many seas which communicate with it. They are, on the contrary, all *turned inwards*, if I may so express myself; losing themselves, in the eastern parts of the tract, in the lakes of a rainless district, in which they supply but the waste of evaporation, and falling, in the western parts, into seas such as the Caspian and the Aral. In this region there are extensive districts still under the level of the ocean. The shore-line of the Caspian, for instance, is rather more than eighty-three feet beneath that of the Black Sea; and some of the great flat steppes which spread out around it, such as what is known as the Steppe of Astracan, have a mean level of about thirty feet beneath that of the Baltic.

Were there a trench-like strip of country that communicated between the Caspian and the Gulf of Finland to be depressed beneath the level of the latter sea, it would *so open the fountains of the great deep* as to lay under water an extensive and populous region, containing the cities of Astracan, and Astrabad, and many other towns and villages. Now is it unworthy of remark, surely, that one of the depressed steppes of this peculiar region is known as the "Low Steppe of the Caucasus," and forms no inconsiderable portion of the great recognized centre of the human family. The Mount Ararat on which, according to many of our commentators, the ark rested, rises immediately on the western edge of this great hollow; the Mount Ararat selected as the scene of that event by Sir Walter Raleigh, certainly not without some show of reason, lies far within it. . . . With the known facts, then, regarding this depressed Asiatic region before us, let us see whether we cannot originate a theory of the Deluge free from at least the palpable monstrosities of the older ones. Let us suppose that the human family, still amounting to several millions, though greatly reduced by exterminating wars and exhausting vices, were congregated in that tract of country which, extending eastwards from the modern Ararat to far beyond the Sea of Aral, includes the original Caucasian centre of the race; let us suppose that, the hour of judgment having at length arrived, the land began gradually to sink, as the tract in the run of Cutch sank in the year 1819, or as the tract in the southern part of North America known as the "sunk country," sank in the year 1821: further, let us suppose that the depression took place slowly and equably for forty days together, at the rate of about four hundred feet per day,—a rate not twice greater than at which the tide rises in the Straits of Magellan, and which would have rendered itself apparent as but a persistent inward flowing of the sea: let us yet farther suppose that, from mayhap some volcanic outburst coincident with the depression, and an effect of the same deep-seated cause, the atmosphere was so affected, that heavy drenching rains continued to descend during the whole time, and that, though they could contribute but little to the actual volume of the flood,—at most only some five or six inches per day,— they at least *seemed* to constitute one of its main causes, and added greatly to its terrors, by swelling the rivers, and rushing downwards in torrents from the hills: the depression, which, by extending to the Euxine Sea and the Persian Gulf on the one hand, and to the Gulf of Finland on the other, would open up by three separate channels the fountains of the great deep, and which included, let us suppose, an area of about two thousand miles each way, would, at the end of the fortieth day, be sunk in its centre to the depth of sixteen thousand feet,—a depth sufficiently profound to bury the loftiest mountains of the district; and yet, having a gradient of declination of but sixteen feet per mile, the contour of its hills and plains would remain apparently what they had been before,—the doomed inhabitants would see but the water rising along the mountain sides, and one refuge after another swept away, till the last witness of the scene would have perished, and the last hill-top would have disappeared. And when, after a hundred and fifty days had come and gone, the depressed hollow would have begun slowly to rise, and when, after the fifth month had passed, the ark would have grounded on the summit of Mount Ararat, all that could have been seen